IGNITION SYSTEM

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DESCRIPTION AND OPERATION

IGNITION SYSTEM

DESCRIPTION

Two different ignition systems are used. One type of system is for the 2.5L 4–cylinder, the 3.9L V-6 engine and the 5.9L V-8 engine. The other is for the 4.7L V-8 engine.

The ignition systems used on 2.5L 4–cylinder, 3.9L V-6 and 5.9L V-8 engines are basically identical using a conventional distributor and remotely mounted coil. The 4.7L V-8 engine does not use a distributor and has 8 separate coils.

OPERATION

The ignition system is controlled by the Powertrain Control Module (PCM) on all engines.

The ignition system consists of:

- Spark Plugs
- Ignition Coil(s)
- Secondary Ignition Cables (2.5L/3.9L/5.9L engines)

DESCRIPTION AND OPERATION (Continued)

- Distributor (contains rotor and camshaft position sensor) (2.5L/3.9L/5.9L engines)
- Powertrain Control Module (PCM)
- Crankshaft Position and Camshaft Position Sensors
- The MAP, TPS, IAC and ECT also have an effect on the control of the ignition system.

DISTRIBUTOR

DESCRIPTION

All 2.5L/3.9L/5.9L engines are equipped with a camshaft driven mechanical distributor (Fig. 1) containing a shaft driven distributor rotor. All distributors are equipped with an internal camshaft position (fuel sync) sensor (Fig. 1).

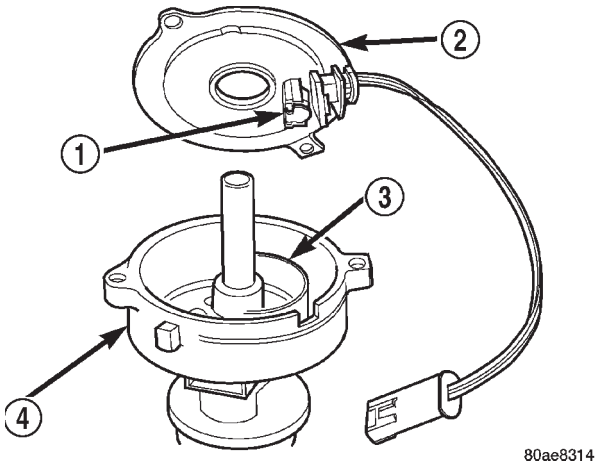


Fig. 1 Distributor and Camshaft Position Sensor-Typical (3.9L/5.9L Shown)

1 – SYNC SIGNAL GENERATOR
2 – CAMSHAFT POSITION SENSOR
3 – PULSE RING
4 – DISTRIBUTOR ASSEMBLY

OPERATION

The camshaft position sensor provides fuel injection synchronization and cylinder identification.

The distributor does not have built in centrifugal or vacuum assisted advance. Base ignition timing and all timing advance is controlled by the Powertrain Control Module (PCM). Because ignition timing is controlled by the PCM, **base ignition timing is not adjustable on any of these engines.**

All 2.5L/3.9L/5.9L distributors contain an internal oil seal that prevents oil from entering the distributor housing. The seal is not serviceable.

SPARK PLUGS

DESCRIPTION

All engines use resistor type spark plugs. 4.7L V-8 engines are equipped with “fired in suppressor seal” type spark plugs using a copper core ground electrode.

Because of the use of an aluminum cylinder head on the 4.7L engine, spark plug torque is very critical.

To prevent possible pre-ignition and/or mechanical engine damage, the correct type/heat range/number spark plug must be used.

OPERATION

Remove the spark plugs and examine them for burned electrodes and fouled, cracked or broken porcelain insulators. Keep plugs arranged in the order in which they were removed from the engine. A single plug displaying an abnormal condition indicates that a problem exists in the corresponding cylinder. Replace spark plugs at the intervals recommended in Group O, Lubrication and Maintenance.

Spark plugs that have low mileage may be cleaned and reused if not otherwise defective, carbon or oil fouled. Also refer to Spark Plug Conditions.

CAUTION: Never use a motorized wire wheel brush to clean the spark plugs. Metallic deposits will remain on the spark plug insulator and will cause plug misfire.

SPARK PLUG CABLES

DESCRIPTION

Spark plug cables are sometimes referred to as secondary ignition wires.

OPERATION

The spark plug cables transfer electrical current from the ignition coil(s) and/or distributor, to individual spark plugs at each cylinder. The resistive spark plug cables are of nonmetallic construction. The cables provide suppression of radio frequency emissions from the ignition system.

IGNITION COIL (EXCEPT 4.7L ENGINE)

DESCRIPTION

A single ignition coil is used. The coil is not oil filled. The coil windings are embedded in an epoxy compound. This provides heat and vibration resistance that allows the coil to be mounted on the engine.

DESCRIPTION AND OPERATION (Continued)

OPERATION

The Powertrain Control Module (PCM) opens and closes the ignition coil ground circuit for ignition coil operation.

Battery voltage is supplied to the ignition coil positive terminal from the ASD relay. If the PCM does not see a signal from the crankshaft and camshaft sensors (indicating the ignition key is ON but the engine is not running), it will shut down the ASD circuit.

Base ignition timing is not adjustable on any engine. By controlling the coil ground circuit, the PCM is able to set the base timing and adjust the ignition timing advance. This is done to meet changing engine operating conditions.

IGNITION COIL—4.7L ENGINE

DESCRIPTION

The 4.7L V–8 engine uses 8 dedicated, and individually fired coil (Fig. 2) for each spark plug. Each coil is mounted directly to the top of each spark plug (Fig. 3).

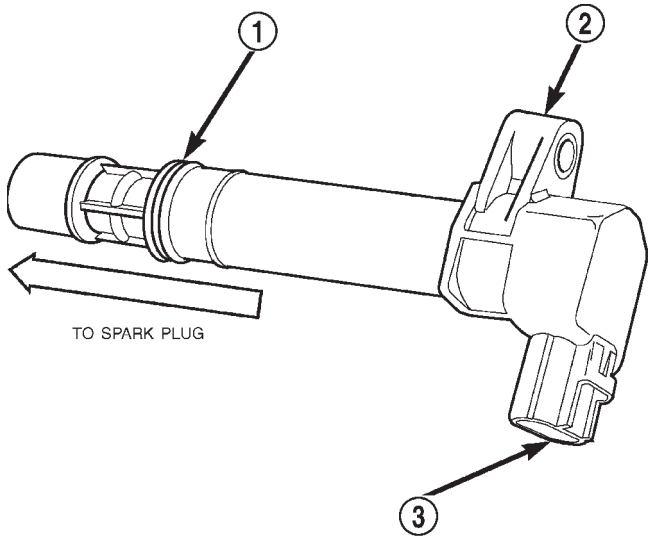


Fig. 2 Ignition Coil—4.7L Engine

1 – O-RING
2 – IGNITION COIL
3 – ELECTRICAL CONNECTOR

OPERATION

Battery voltage is supplied to the 8 ignition coils from the ASD relay. The Powertrain Control Module (PCM) opens and closes each ignition coil ground circuit at a determined time for ignition coil operation.

Base ignition timing is not adjustable. By controlling the coil ground circuit, the PCM is able to set the base timing and adjust the ignition timing advance. This is done to meet changing engine operating conditions.

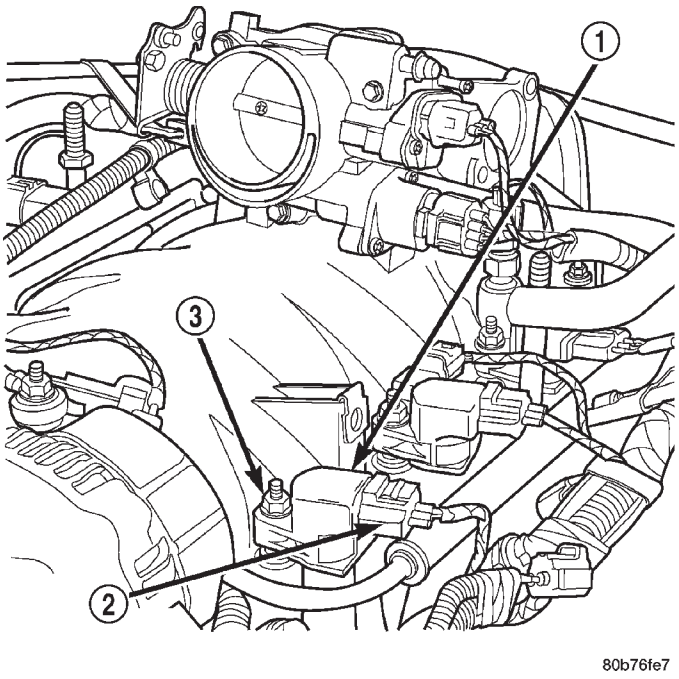


Fig. 3 Ignition Coil Location—4.7L Engine

1 – IGNITION COIL
2 – COIL ELECTRICAL CONNECTOR
3 – COIL MOUNTING STUD/NUT

The ignition coil is not oil filled. The windings are embedded in an epoxy compound. This provides heat and vibration resistance that allows the ignition coil to be mounted on the engine.

Because of coil design, spark plug cables (secondary cables) are not used.

CRANKSHAFT POSITION SENSOR—2.5L ENGINE

DESCRIPTION

The Crankshaft Position (CKP) sensor is located near the outer edge of the flywheel (or starter ringear).

OPERATION

Engine speed and crankshaft position are provided through the CKP sensor. The sensor generates pulses that are the input sent to the Powertrain Control Module (PCM). The PCM interprets the sensor input to determine the crankshaft position. The PCM then uses this position, along with other inputs, to determine injector sequence and ignition timing.

The sensor is a hall effect device combined with an internal magnet. It is also sensitive to steel within a certain distance from it.

DESCRIPTION AND OPERATION (Continued)

The flywheel/drive plate has groups of four notches at its outer edge. On 2.5L 4-cylinder engines there are two sets of notches (Fig. 4).

The notches cause a pulse to be generated when they pass under the sensor. The pulses are the input to the PCM. For each engine revolution there are two groups of four pulses generated on 2.5L 4-cylinder engines.

The trailing edge of the fourth notch, which causes the pulse, is four degrees before top dead center (TDC) of the corresponding piston.

The engine will not operate if the PCM does not receive a CKP sensor input.

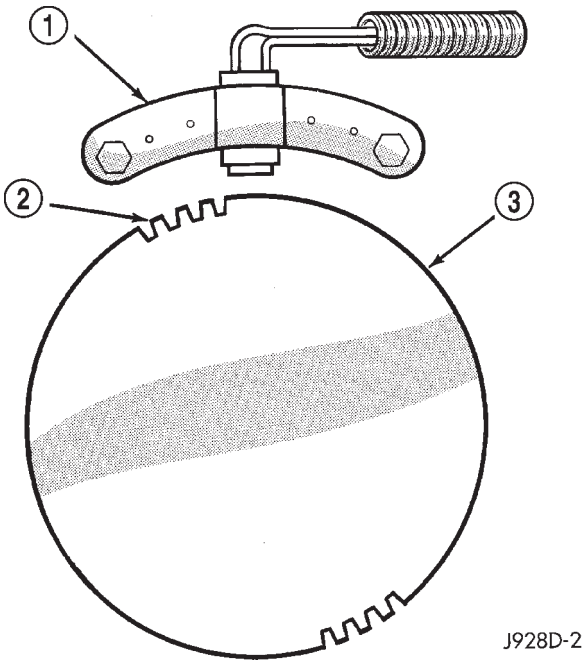


Fig. 4 CKP Sensor Operation—2.5L 4-Cyl. Engine

1 – CRANKSHAFT POSITION SENSOR
2 – NOTCHES
3 – FLYWHEEL

The sensor is a hall effect device combined with an internal magnet. It is also sensitive to steel within a certain distance from it.

The flywheel/drive plate has groups of notches at its outer edge. On 3.9L V-6 engines, there are three sets of double notches and three sets of single notches (Fig. 5).

The notches cause a pulse to be generated when they pass under the sensor. The pulses are the input to the PCM.

The engine will not operate if the PCM does not receive a CKP sensor input.

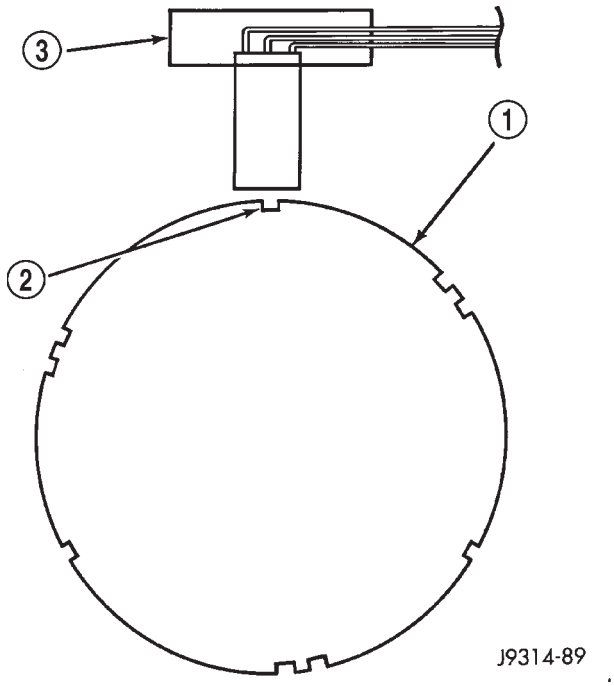


Fig. 5 CKP Sensor Operation—3.9L Engine

1 – FLYWHEEL
2 – NOTCHES
3 – CRANKSHAFT POSITION SENSOR

CRANKSHAFT POSITION SENSOR—3.9L V-6 ENGINE

DESCRIPTION

The Crankshaft Position (CKP) sensor is located near the outer edge of the flywheel (starter ringear).

OPERATION

Engine speed and crankshaft position are provided through the CKP sensor. The sensor generates pulses that are the input sent to the Powertrain Control Module (PCM). The PCM interprets the sensor input to determine the crankshaft position. The PCM then uses this position, along with other inputs, to determine injector sequence and ignition timing.

CRANKSHAFT POSITION SENSOR—5.2/5.9L V-8 ENGINE

DESCRIPTION

The Crankshaft Position (CKP) sensor is located near the outer edge of the flywheel (starter ringear).

OPERATION

Engine speed and crankshaft position are provided through the CKP sensor. The sensor generates pulses that are the input sent to the Powertrain Control Module (PCM). The PCM interprets the sensor input to determine the crankshaft position. The PCM then uses this position, along with other inputs, to determine injector sequence and ignition timing.

DESCRIPTION AND OPERATION (Continued)

The sensor is a hall effect device combined with an internal magnet. It is also sensitive to steel within a certain distance from it.

On 5.2/5.9L V-8 engines, the flywheel/drive plate has 8 single notches, spaced every 45 degrees, at its outer edge (Fig. 6).

The notches cause a pulse to be generated when they pass under the sensor. The pulses are the input to the PCM. For each engine revolution, there are 8 pulses generated on V-8 engines.

The engine will not operate if the PCM does not receive a CKP sensor input.

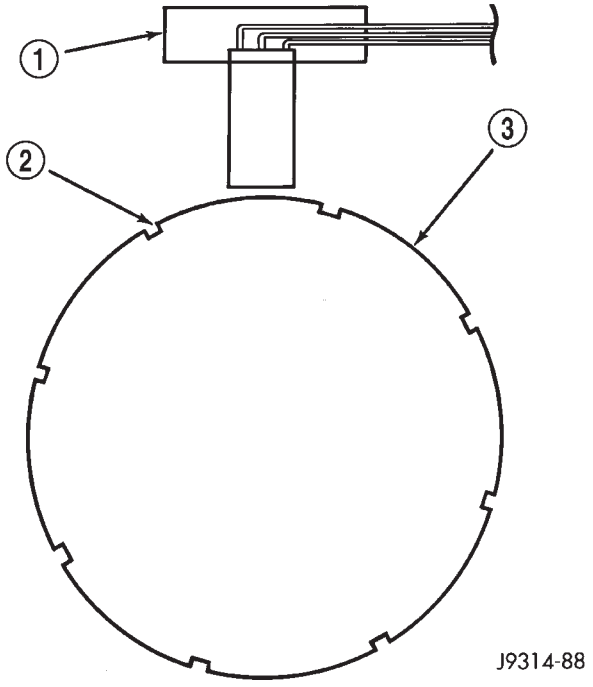


Fig. 6 CKP Sensor Operation—5.2L/5.9L Engine

1 – CRANKSHAFT POSITION SENSOR
2 – NOTCHES
3 – FLYWHEEL

CRANKSHAFT POSITION SENSOR—4.7L ENGINE

DESCRIPTION

The Crankshaft Position Sensor (CKP) is mounted into the right-rear side of the engine block (Fig. 7).

OPERATION

Engine speed and crankshaft position are provided through the crankshaft position sensor. The sensor generates pulses that are the input sent to the powertrain control module (PCM). The PCM interprets the sensor input to determine the crankshaft position. The PCM then uses this position, along with other inputs, to determine injector sequence and ignition timing.

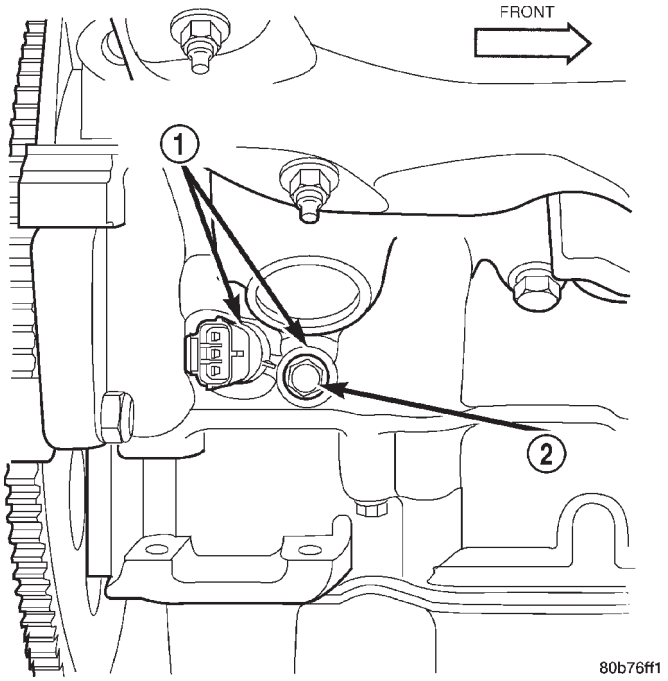


Fig. 7 CKP Sensor Location—4.7L V–8 Engine

1 – CRANKSHAFT POSITION SENSOR
2 – MOUNTING BOLT

The sensor is a hall effect device combined with an internal magnet. It is also sensitive to steel within a certain distance from it.

On the 4.7L V–8 engine, a tonewheel is bolted to the engine crankshaft (Fig. 8). This tonewheel has sets of notches at its outer edge (Fig. 8).

The notches cause a pulse to be generated when they pass under the sensor. The pulses are the input to the PCM.

CAMSHAFT POSITION SENSOR

DESCRIPTION

The Camshaft Position (CMP) sensor is located in the distributor.

OPERATION

The sensor contains a hall effect device called a sync signal generator to generate a fuel sync signal. This sync signal generator detects a rotating pulse ring (shutter) on the distributor shaft. The pulse ring rotates 180 degrees through the sync signal generator. Its signal is used in conjunction with the Crankshaft Position (CKP) sensor to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders.

When the leading edge of the pulse ring (shutter) enters the sync signal generator, the following occurs: The interruption of magnetic field causes the voltage

DESCRIPTION AND OPERATION (Continued)

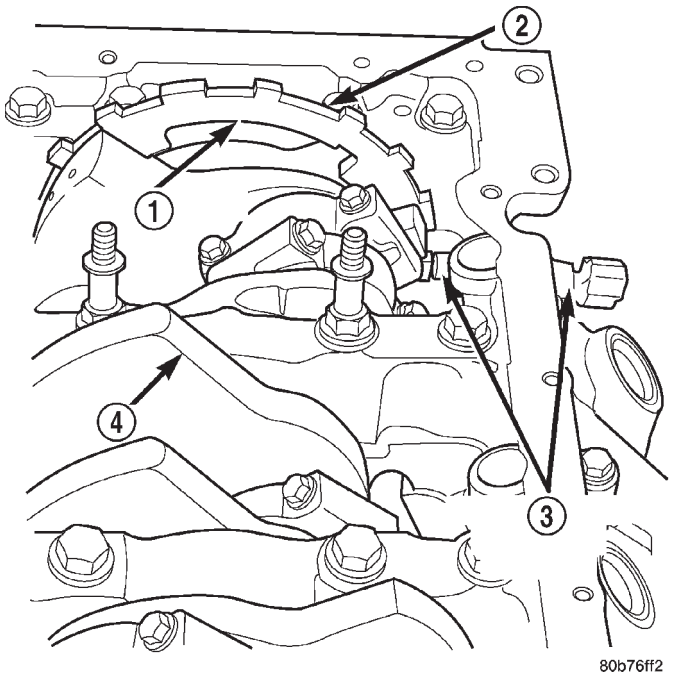


Fig. 8 CKP Sensor Operation and Tonewheel—4.7L V–8 Engine

1 – TONEWHEEL
2 – NOTCHES
3 – CRANKSHAFT POSITION SENSOR
4 – CRANKSHAFT

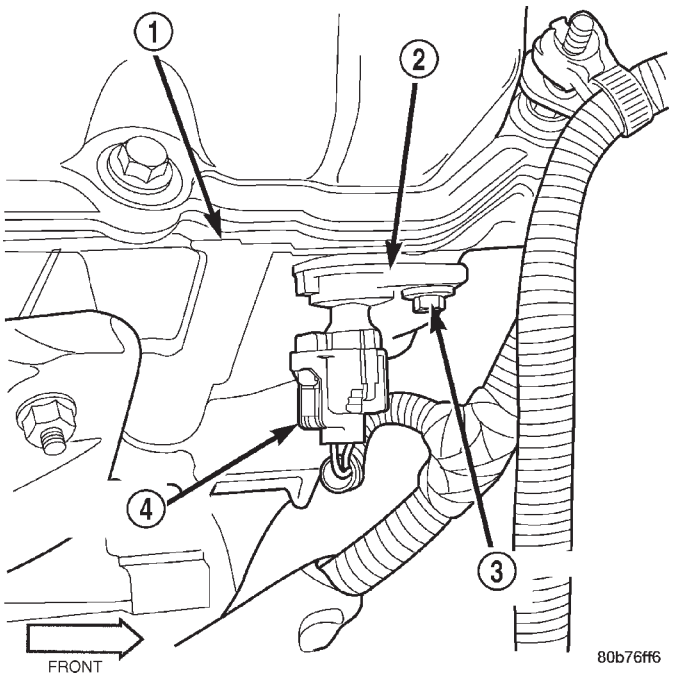


Fig. 9 CMP Location—4.7L Engine

1 – RIGHT CYLINDER HEAD
2 – CAMSHAFT POSITION SENSOR
3 – MOUNTING BOLT
4 – ELEC. CONNECTOR

to switch high resulting in a sync signal of approximately 5 volts.

When the trailing edge of the pulse ring (shutter) leaves the sync signal generator, the following occurs: The change of the magnetic field causes the sync signal voltage to switch low to 0 volts.

CAMSHAFT POSITION SENSOR—4.7L ENGINE

DESCRIPTION

The Camshaft Position Sensor (CMP) on the 4.7L V–8 engine is bolted to the front/top of the right cylinder head (Fig. 9).

OPERATION

The CMP sensor contains a hall effect device called a sync signal generator to generate a fuel sync signal. This sync signal generator detects notches located on a tonewheel. The tonewheel is located at the front of the camshaft for the right cylinder head (Fig. 10). As the tonewheel rotates, the notches pass through the sync signal generator. The pattern of the notches (viewed counter-clockwise from front of engine) is: 1 notch, 2 notches, 3 notches, 3 notches, 2 notches 1 notch, 3 notches and 1 notch. The signal from the CMP sensor is used in conjunction with the crankshaft position sensor to differentiate between fuel injection and spark events. It is also used to synchronize the fuel injectors with their respective cylinders.

IGNITION SWITCH AND KEY LOCK CYLINDER

DESCRIPTION

The electrical ignition switch is located on the steering column. It is used as the main on/off switching device for most electrical components. The mechanical key lock cylinder is used to engage/disengage the electrical ignition switch.

OPERATION

Vehicles equipped with an automatic transmission and a floor mounted shifter: a cable is used to connect the interlock device in the steering column assembly, to the transmission floor shift lever. This interlock device is used to lock the transmission shifter in the PARK position when the key lock cylinder is rotated to the LOCKED or ACCESSORY position. The interlock device within the steering column is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

If the ignition key is difficult to rotate to or from the LOCK or ACCESSORY position, it may not be the fault of the key cylinder or the steering column

DESCRIPTION AND OPERATION (Continued)

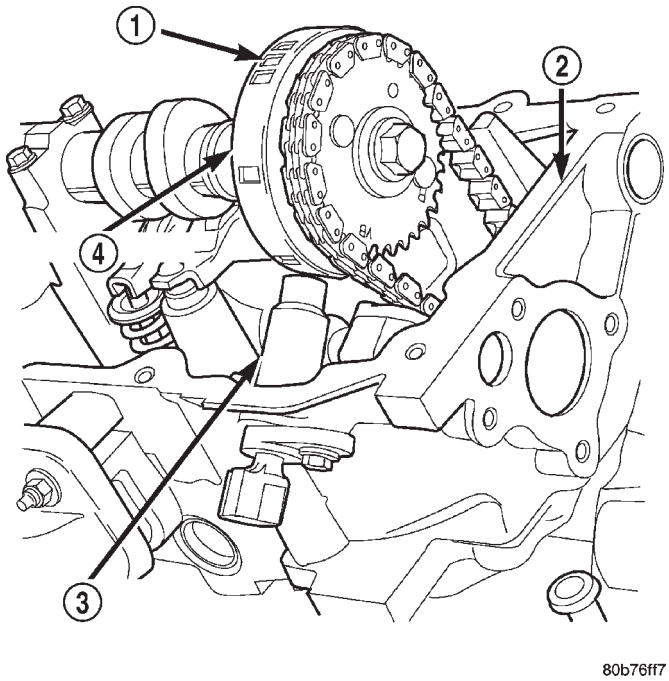


Fig. 10 CMP Sensor and Tonewheel—4.7L Engine

1 – NOTCHES
2 – RIGHT CYLINDER HEAD
3 – CAMSHAFT POSITION SENSOR
4 – TONEWHEEL

components. The brake transmission shift interlock cable may be out of adjustment. Refer to Brake Transmission Shift Interlock Cable Adjustment in Group 21, Transmissions for adjustment procedures.

Vehicles equipped with an automatic transmission and a steering column mounted shifter: an interlock device is located within the steering column. This interlock device is used to lock the transmission shifter in the PARK position when the key lock cylinder is in the LOCKED or ACCESSORY position. If it is difficult to rotate the key to or from the LOCK or ACCESSORY position, the interlock device within the steering column may be defective. This device is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

Vehicles equipped with a manual transmission, a floor mounted shifter, and a LEVER below the ignition key: A lever is located on the steering column behind the ignition key lock cylinder. The lever must be manually operated to allow rotation of the ignition key lock cylinder to the LOCK or ACCESSORY position. If it is difficult to rotate the key to the LOCK or ACCESSORY position, the lever mechanism may be defective. This mechanism is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

Vehicles equipped with a manual transmission, a floor mounted shifter, and NO LEVER below the ignition key: The ignition key cylinder must be depressed to allow it to be rotated into the LOCK or ACCESSORY position. If it is difficult to rotate the key to the LOCK or ACCESSORY position, the lock mechanism within the steering column may be defective. This mechanism is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

DIAGNOSIS AND TESTING

DISTRIBUTOR CAP

Remove the distributor cap and wipe it clean with a dry lint free cloth. Visually inspect the cap for cracks, carbon paths, broken towers or damaged rotor button (Fig. 11) or (Fig. 12). Also check for white deposits on the inside (caused by condensation entering the cap through cracks). Replace any cap that displays charred or eroded terminals. The machined surface of a terminal end (faces toward rotor) will indicate some evidence of erosion from normal operation. Examine the terminal ends for evidence of mechanical interference with the rotor tip.

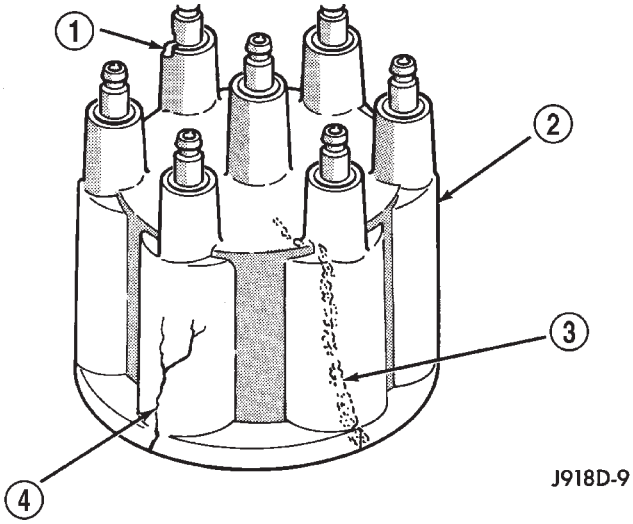


Fig. 11 Cap Inspection—External—Typical

1 – BROKEN TOWER
2 – DISTRIBUTOR CAP
3 – CARBON PATH
4 – CRACK

DISTRIBUTOR ROTOR

Visually inspect the rotor (Fig. 13) for cracks, evidence of corrosion or the effects of arcing on the metal tip. Also check for evidence of mechanical interference with the cap. Some charring is normal on the end of the metal tip. The silicone-dielectric-

DIAGNOSIS AND TESTING (Continued)

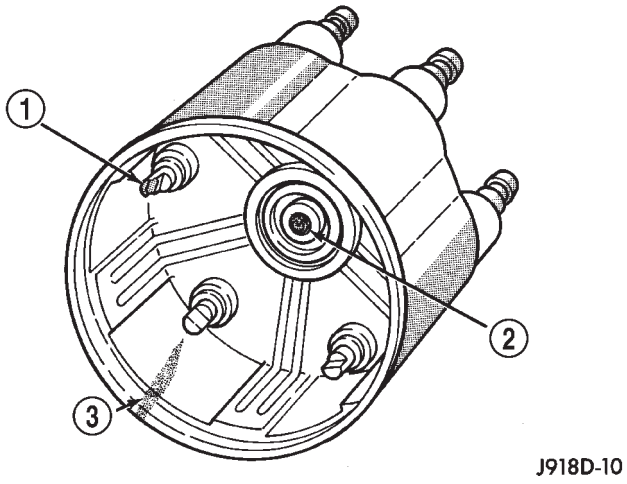


Fig. 12 Cap Inspection—Internal—Typical

1 – CHARRED OR ERODED TERMINALS
2 – WORN OR DAMAGED ROTOR BUTTON
3 – CARBON PATH

varnish-compound applied to the rotor tip for radio interference noise suppression, will appear charred. This is normal. **Do not remove the charred compound.** Test the spring for insufficient tension. Replace a rotor that displays any of these adverse conditions.

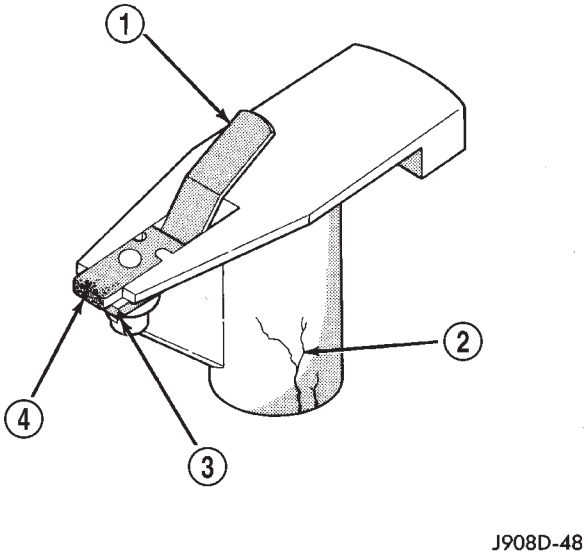


Fig. 13 Rotor Inspection—Typical

1 – INSUFFICIENT SPRING TENSION
2 – CRACKS
3 – EVIDENCE OF PHYSICAL CONTACT WITH CAP
4 – ROTOR TIP CORRODED

SPARK PLUG CABLES

Check the spark plug cable connections for good contact at the coil(s), distributor cap towers, and spark plugs. Terminals should be fully seated. The insulators should be in good condition and should fit tightly on the coil, distributor and spark plugs. Spark plug cables with insulators that are cracked or torn must be replaced.

Clean high voltage ignition cables with a cloth moistened with a non-flammable solvent. Wipe the cables dry. Check for brittle or cracked insulation.

On 3.9L V-6 and 5.2/5.9L V-8 engines, spark plug cable heat shields are pressed into the cylinder head to surround each spark plug cable boot and spark plug (Fig. 14). These shields protect the spark plug boots from damage (due to intense engine heat generated by the exhaust manifolds) and should not be removed. After the spark plug cable has been installed, the lip of the cable boot should have a small air gap to the top of the heat shield (Fig. 14).

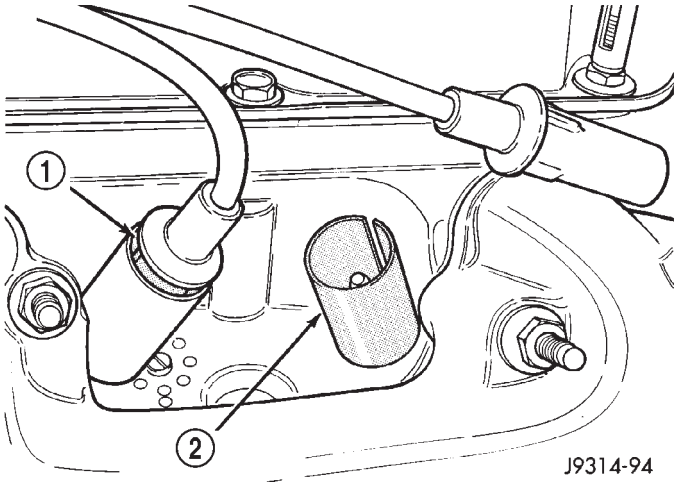


Fig. 14 Heat Shields—3.9/5.2/5.9L Engines

1 – AIR GAP
2 – SPARK PLUG BOOT HEAT SHIELD

TESTING

When testing secondary cables for damage with an oscilloscope, follow the instructions of the equipment manufacturer.

If an oscilloscope is not available, spark plug cables may be tested as follows:

CAUTION: Do not leave any one spark plug cable disconnected for longer than necessary during testing. This may cause possible heat damage to the catalytic converter. Total test time must not exceed ten minutes.

With the engine running, remove spark plug cable from spark plug (one at a time) and hold next to a good engine ground. If the cable and spark plug are in good condition, the engine rpm should drop and the engine will run poorly. If engine rpm does not drop, the cable and/or spark plug may not be operat-

DIAGNOSIS AND TESTING (Continued)

ing properly and should be replaced. Also check engine cylinder compression.

With the engine not running, connect one end of a test probe to a good ground. Start the engine and run the other end of the test probe along the entire length of all spark plug cables. If cables are cracked or punctured, there will be a noticeable spark jump from the damaged area to the test probe. The cable running from the ignition coil to the distributor cap can be checked in the same manner. Cracked, damaged or faulty cables should be replaced with resistance type cable. This can be identified by the words ELECTRONIC SUPPRESSION printed on the cable jacket.

Use an ohmmeter to test for open circuits, excessive resistance or loose terminals. If equipped, remove the distributor cap from the distributor. **Do not remove cables from cap.** Remove cable from spark plug. Connect ohmmeter to spark plug terminal end of cable and to corresponding electrode in distributor cap. Resistance should be 250 to 1000 Ohms per inch of cable. If not, remove cable from distributor cap tower and connect ohmmeter to the terminal ends of cable. If resistance is not within specifications as found in the SPARK PLUG CABLE RESISTANCE chart, replace the cable. Test all spark plug cables in this manner.

SPARK PLUG CABLE RESISTANCE

MINIMUM	MAXIMUM
250 Ohms Per Inch	1000 Ohms Per Inch
3000 Ohms Per Foot	12,000 Ohms Per Foot

To test ignition coil-to-distributor cap cable, do not remove the cable from the cap. Connect ohmmeter to rotor button (center contact) of distributor cap and terminal at ignition coil end of cable. If resistance is not within specifications as found in the Spark Plug Cable Resistance chart, remove the cable from the distributor cap. Connect the ohmmeter to the terminal ends of the cable. If resistance is not within specifications as found in the Spark Plug Cable Resistance chart, replace the cable. Inspect the ignition coil tower for cracks, burns or corrosion.

SPARK PLUG CONDITIONS

NORMAL OPERATING

The few deposits present on the spark plug will probably be light tan or slightly gray in color. This is evident with most grades of commercial gasoline (Fig. 15). There will not be evidence of electrode burning. On all engines except the 4.7L V-8, gap growth will not average more than approximately 0.025 mm (.001 in) per 3200 km (2000 miles) of operation. On the 4.7L V-8, gap growth will not average more than approximately.0015 in per 3200 km (2000 miles) of operation. Spark plugs that have normal wear can usually be cleaned, have the electrodes filed, have the gap set and then be installed.

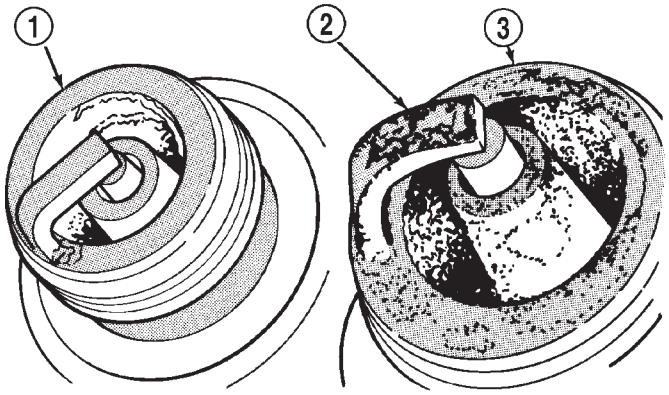


Fig. 15 Normal Operation and Cold (Carbon) Fouling

1 – NORMAL
2 – DRY BLACK DEPOSITS
3 – COLD (CARBON) FOULING

Some fuel refiners in several areas of the United States have introduced a manganese additive (MMT) for unleaded fuel. During combustion, fuel with MMT causes the entire tip of the spark plug to be coated with a rust colored deposit. This rust color can be misdiagnosed as being caused by coolant in the combustion chamber. Spark plug performance may be affected by MMT deposits.

COLD FOULING/CARBON FOULING

Cold fouling is sometimes referred to as carbon fouling. The deposits that cause cold fouling are basically carbon (Fig. 15). A dry, black deposit on one or two plugs in a set may be caused by sticking valves or defective spark plug cables. Cold (carbon) fouling of the entire set of spark plugs may be caused by a clogged air cleaner element or repeated short operating times (short trips).

WET FOULING OR GAS FOULING

A spark plug coated with excessive wet fuel or oil is wet fouled. In older engines, worn piston rings, leaking valve guide seals or excessive cylinder wear can cause wet fouling. In new or recently overhauled engines, wet fouling may occur before break-in (normal oil control) is achieved. This condition can usually be resolved by cleaning and reinstalling the fouled plugs.

DIAGNOSIS AND TESTING (Continued)

OIL OR ASH ENCRUSTED

If one or more spark plugs are oil or oil ash encrusted (Fig. 16), evaluate engine condition for the cause of oil entry into that particular combustion chamber.

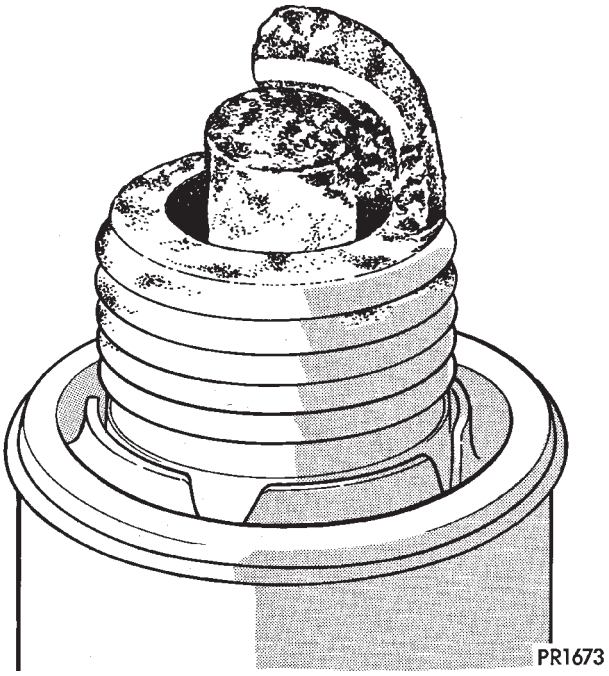


Fig. 16 Oil or Ash Encrusted

ELECTRODE GAP BRIDGING

Electrode gap bridging may be traced to loose deposits in the combustion chamber. These deposits accumulate on the spark plugs during continuous stop-and-go driving. When the engine is suddenly subjected to a high torque load, deposits partially liquefy and bridge the gap between electrodes (Fig. 17). This short circuits the electrodes. Spark plugs with electrode gap bridging can be cleaned using standard procedures.

SCAVENGER DEPOSITS

Fuel scavenger deposits may be either white or yellow (Fig. 18). They may appear to be harmful, but this is a normal condition caused by chemical additives in certain fuels. These additives are designed to change the chemical nature of deposits and decrease spark plug misfire tendencies. Notice that accumulation on the ground electrode and shell area may be heavy, but the deposits are easily removed. Spark plugs with scavenger deposits can be considered normal in condition and can be cleaned using standard procedures.

CHIPPED ELECTRODE INSULATOR

A chipped electrode insulator usually results from bending the center electrode while adjusting the spark plug electrode gap. Under certain conditions, severe detonation can also separate the insulator from the center electrode (Fig. 19). Spark plugs with this condition must be replaced.

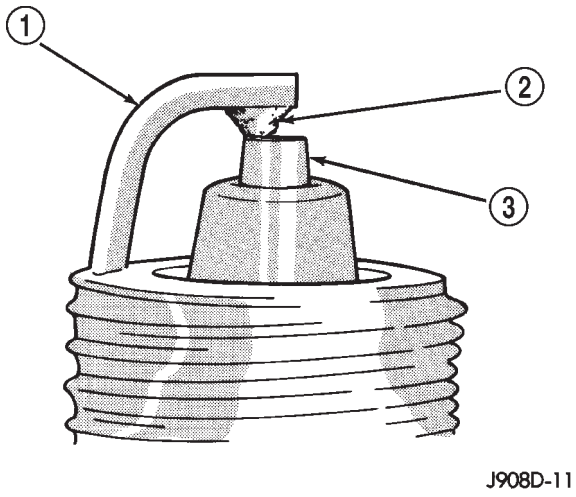


Fig. 17 Electrode Gap Bridging

1 – GROUND ELECTRODE
2 – DEPOSITS
3 – CENTER ELECTRODE

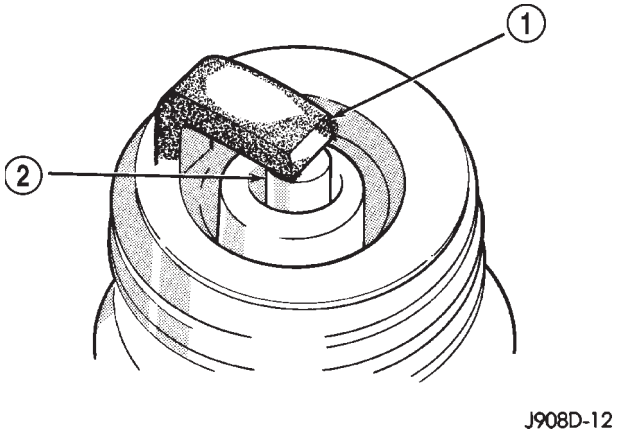


Fig. 18 Scavenger Deposits

1 – GROUND ELECTRODE COVERED WITH WHITE OR YELLOW DEPOSITS
2 – CENTER ELECTRODE

PREIGNITION DAMAGE

Preignition damage is usually caused by excessive combustion chamber temperature. The center electrode dissolves first and the ground electrode dissolves somewhat latter (Fig. 20). Insulators appear relatively deposit free. Determine if the spark plug has the correct heat range rating for the engine. Determine if ignition timing is over advanced or if other operating conditions are causing engine overheating. (The heat range rating refers to the operating temperature of a particular type spark plug.

DIAGNOSIS AND TESTING (Continued)

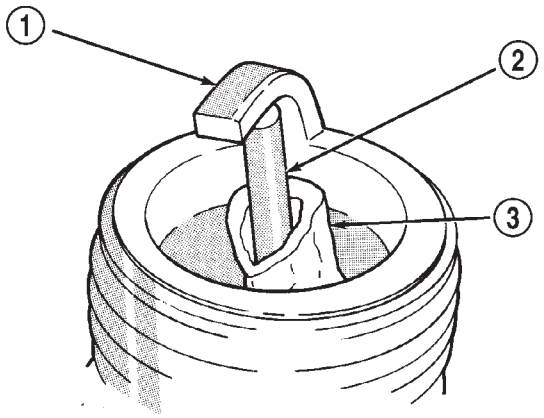


Fig. 19 Chipped Electrode Insulator

1 – GROUND ELECTRODE
2 – CENTER ELECTRODE
3 – CHIPPED INSULATOR

Spark plugs are designed to operate within specific temperature ranges. This depends upon the thickness and length of the center electrodes porcelain insulator.)

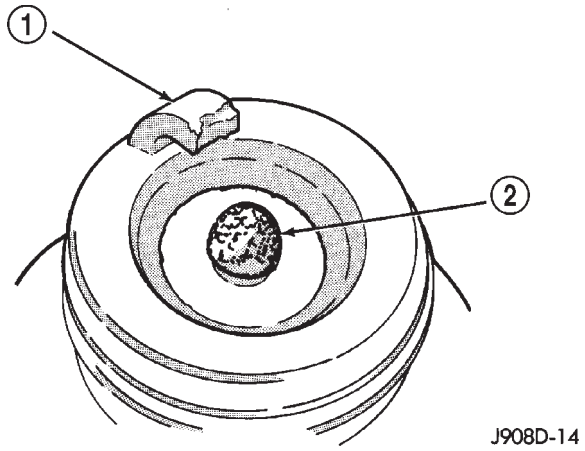


Fig. 20 Preignition Damage

1 – GROUND ELECTRODE STARTING TO DISSOLVE
2 – CENTER ELECTRODE DISSOLVED

SPARK PLUG OVERHEATING

Overheating is indicated by a white or gray center electrode insulator that also appears blistered (Fig. 21). The increase in electrode gap will be considerably in excess of 0.001 inch per 2000 miles of operation. This suggests that a plug with a cooler heat range rating should be used. Over advanced ignition timing, detonation and cooling system malfunctions can also cause spark plug overheating.

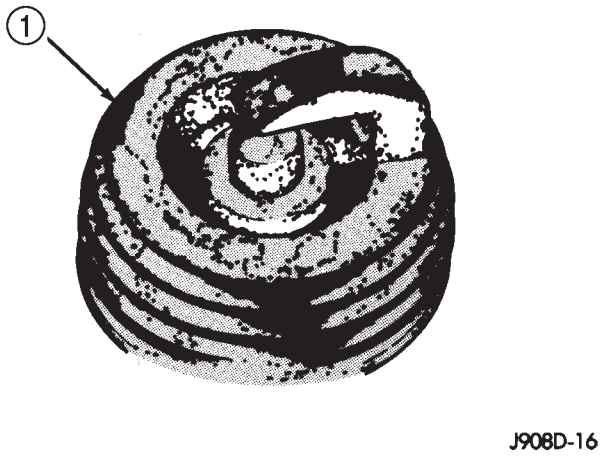


Fig. 21 Spark Plug Overheating

1 – BLISTERED WHITE OR GRAY COLORED INSULATOR

IGNITION SWITCH AND KEY LOCK CYLINDER

ELECTRICAL DIAGNOSIS

For ignition switch electrical schematics, refer to Ignition Switch in Group 8W, Wiring Diagrams.

MECHANICAL DIAGNOSIS (KEY DIFFICULT TO ROTATE)

Vehicles equipped with an automatic transmission and a floor mounted shifter: a cable is used to connect the interlock device in the steering column assembly, to the transmission floor shift lever. This interlock device is used to lock the transmission shifter in the PARK position when the key lock cylinder is rotated to the LOCKED or ACCESSORY position. The interlock device within the steering column is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

If the ignition key is difficult to rotate to or from the LOCK or ACCESSORY position, it may not be the fault of the key cylinder or the steering column components. The brake transmission shift interlock cable may be out of adjustment. Refer to Brake Transmission Shift Interlock Cable Adjustment in Group 21, Transmissions for adjustment procedures.

Vehicles equipped with an automatic transmission and a steering column mounted shifter: an interlock device is located within the steering column. This interlock device is used to lock the transmission shifter in the PARK position when the key lock cylinder is in the LOCKED or ACCESSORY position. If it is difficult to rotate the key to or from the LOCK or ACCESSORY position, the interlock device within the steering column may be defective. This device is not serviceable. If repair is necessary,

DIAGNOSIS AND TESTING (Continued)

the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

Vehicles equipped with a manual transmission and a floor mounted shifter: on certain models, a lever is located on the steering column behind the ignition key lock cylinder. The lever must be manually operated to allow rotation of the ignition key lock cylinder to the LOCK or ACCESSORY position. If it is difficult to rotate the key to the LOCK or ACCESSORY position, the lever mechanism may be defective. This mechanism is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

On other models, the ignition key cylinder must be depressed to allow it to be rotated into the LOCK or ACCESSORY position. If it is difficult to rotate the key to the LOCK or ACCESSORY position, the lock mechanism within the steering column may be defective. This mechanism is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

REMOVAL AND INSTALLATION

SPARK PLUG CABLES

CAUTION: When disconnecting a high voltage cable from a spark plug or from the distributor cap, twist the rubber boot slightly (1/2 turn) to break it loose (Fig. 22). Grasp the boot (not the cable) and pull it off with a steady, even force.

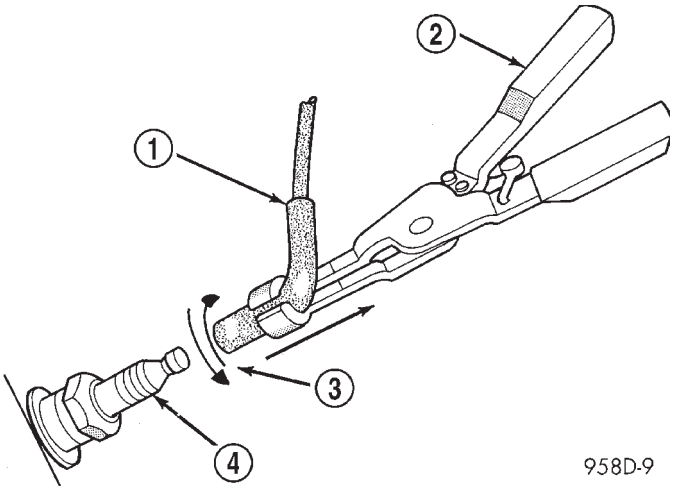


Fig. 22 Cable Removal

1 – SPARK PLUG CABLE AND BOOT
2 – SPARK PLUG BOOT PULLER
3 – TWIST AND PULL
4 – SPARK PLUG

Install cables into the proper engine cylinder firing order (Fig. 23), (Fig. 24) or (Fig. 25).

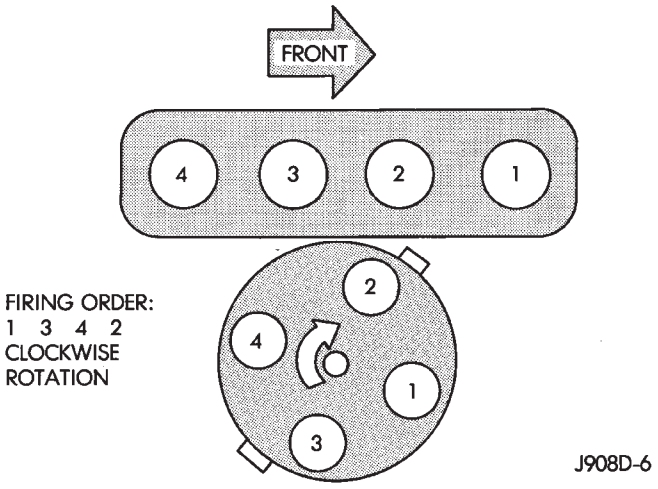


Fig. 23 Engine Firing Order—2.5L 4–Cyl. Engine

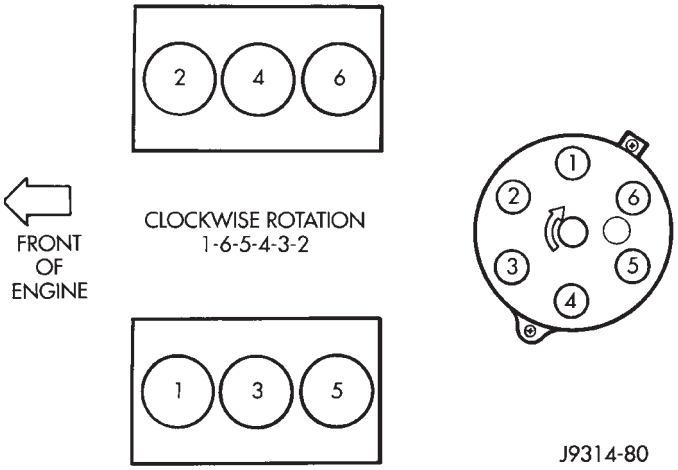


Fig. 24 Engine Firing Order—3.9L V-6 Engine

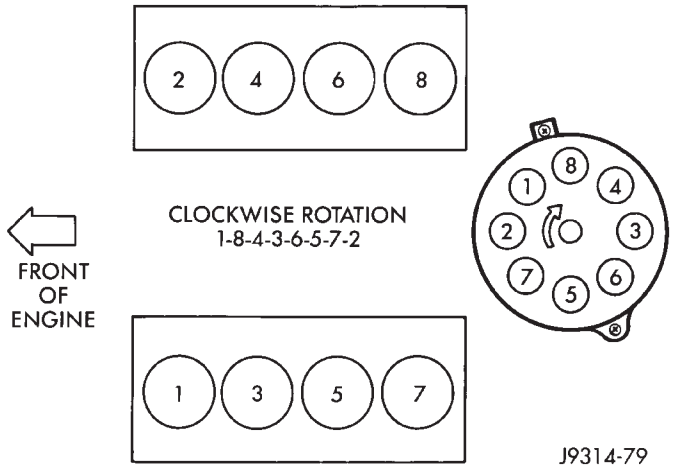


Fig. 25 Engine Firing Order—5.2/5.9L V-8 Engine

When replacing the spark plug and coil cables, route the cables correctly and secure in the proper

REMOVAL AND INSTALLATION (Continued)

retainers. Failure to route the cables properly can cause the radio to reproduce ignition noise. It could also cause cross ignition of the plugs or short circuit the cables to ground.

When installing new cables, make sure a positive connection is made. A snap should be felt when a good connection is made between the plug cable and the distributor cap tower.

SPARK PLUGS

REMOVAL

On 3.9L V-6 and 5.2/5.9L V-8 engines, spark plug cable heat shields are pressed into the cylinder head to surround each cable boot and spark plug (Fig. 26).

If removal of the heat shield(s) is necessary,

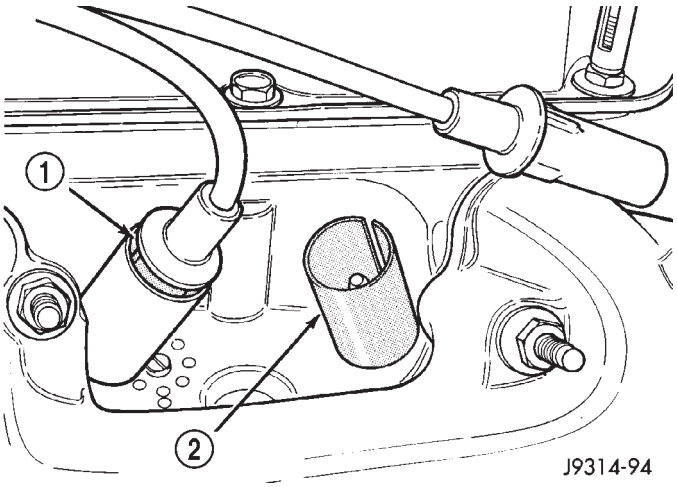


Fig. 26 Heat Shields—3.9/5.2/5.9L Engines

1 – AIR GAP
2 – SPARK PLUG BOOT HEAT SHIELD

remove the spark plug cable and compress the sides of shield for removal. Each shield is slotted to allow for compression and removal. To install the shields, align shield to machined opening in cylinder head and tap into place with a block of wood.

4.7L V–8 Engine: Each individual spark plug is located under each ignition coil. Each individual ignition coil must be removed to gain access to each spark plug. Refer to Ignition Coil Removal/Installation.

(1) Except 4.7L Engine: Prior to removing spark plug, spray compressed air around spark plug hole and area around spark plug. This will help prevent foreign material from entering combustion chamber.

(2) 4.7L V–8 Engine: Prior to removing spark plug, spray compressed air around base of ignition coil at cylinder head. This will help prevent foreign material from entering combustion chamber.

(3) Remove spark plug from cylinder head using a quality socket with a rubber or foam insert. If equipped with a 4.7L V-8 engine, also check condition of coil o-ring and replace as necessary.

(4) Except 4.7L: Always remove spark plug or ignition coil cables by grasping at the cable boot (Fig. 22). Turn the cable boot 1/2 turn and pull straight back in a steady motion. Never pull directly on the cable. Internal damage to cable will result.

(5) Inspect spark plug condition. Refer to Spark Plug Conditions.

CLEANING

The plugs may be cleaned using commercially available spark plug cleaning equipment. After cleaning, file the center electrode flat with a small point file or jewelers file before adjusting gap.

CAUTION: Never use a motorized wire wheel brush to clean the spark plugs. Metallic deposits will remain on the spark plug insulator and will cause plug misfire.

GAP ADJUSTMENT

Check the spark plug gap with a gap gauge tool. If the gap is not correct, adjust it by bending the ground electrode (Fig. 27). **Never attempt to adjust the gap by bending the center electrode.**

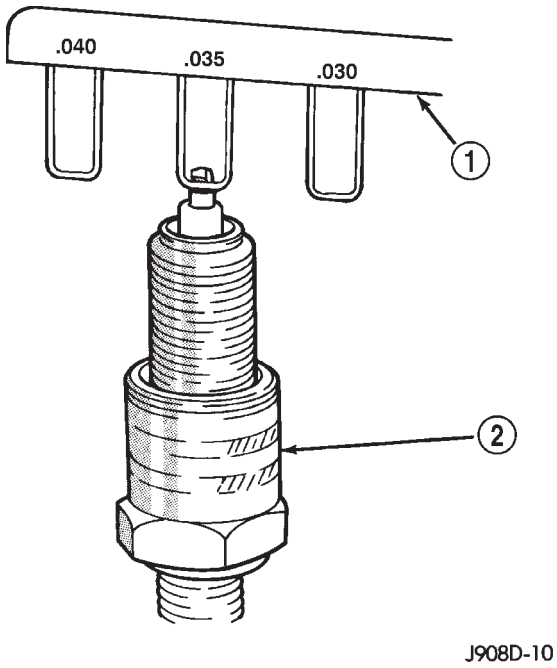


Fig. 27 Setting Spark Plug Gap—Typical

1 – GAUGE
2 – SPARK PLUG

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

CAUTION: The 4.7L V–8 engine is equipped with copper core ground electrode spark plugs. They must be replaced with the same type/number spark plug as the original. If another spark plug is substituted, pre-ignition will result.

Special care should be taken when installing spark plugs into the cylinder head spark plug wells. Be sure the plugs do not drop into the plug wells as electrodes can be damaged.

Always tighten spark plugs to the specified torque. Over tightening can cause distortion resulting in a change in the spark plug gap or a cracked porcelain insulator.

Except 4.7L Engine: When replacing the spark plug and ignition coil cables, route the cables correctly and secure them in the appropriate retainers. Failure to route the cables properly can cause the radio to reproduce ignition noise. It could cause cross ignition of the spark plugs or short circuit the cables to ground.

(1) Start the spark plug into the cylinder head by hand to avoid cross threading.

(2) Except 4.7L Engine: Tighten spark plugs to 35-41 N·m (26-30 ft. lbs.) torque.

(3) Except 4.7L Engine: Install spark plug cables over spark plugs.

(4) 4.7L V–8 Engine: Tighten spark plugs to 27 N·m (20 ft. lbs.) torque.

(5) 4.7L V–8 Engine: Before installing coil(s), check condition of coil o-ring and replace as necessary. To aid in coil installation, apply silicone to coil o-ring.

(6) 4.7L V–8 Engine: Install ignition coil(s). Refer to Ignition Coil Removal/Installation.

IGNITION COIL—2.5L ENGINE

The ignition coil is an epoxy filled type. If the coil is replaced, it must be replaced with the same type.

REMOVAL

The ignition coil is mounted to a bracket on the side of the engine to the rear of the distributor (Fig. 28).

(1) Disconnect the ignition coil secondary cable from ignition coil (Fig. 28).

(2) Disconnect engine harness connector from ignition coil.

(3) Remove ignition coil mounting bolts (nuts may also be used on back side of bracket).

(4) Remove coil.

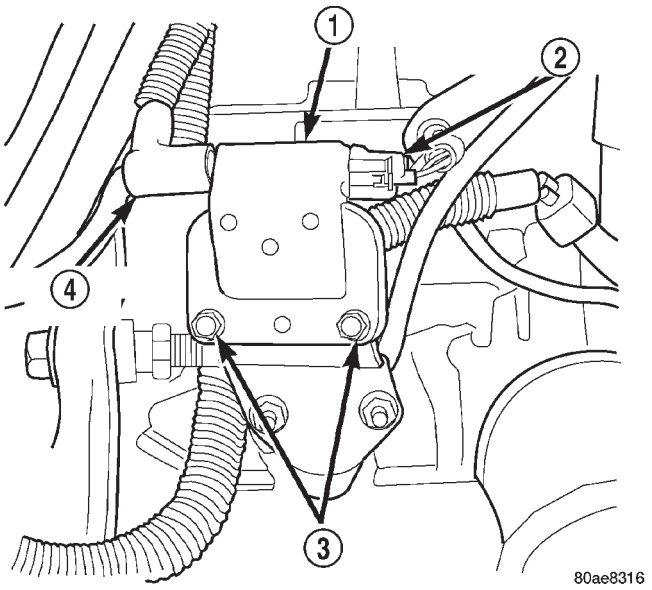


Fig. 28 Ignition Coil—2.5L Engine

1 – IGNITION COIL
2 – ELECTRICAL CONNECTOR
3 – MOUNTING BOLTS (2)
4 – SECONDARY CABLE

INSTALLATION

(1) Install ignition coil to bracket. If nut and bolts are used to secure coil to coil bracket, tighten to 11 N·m (100 in. lbs.) torque. If bolts are used, tighten bolts to 5 N·m (50 in. lbs.) torque.

(2) Connect engine harness connector to coil.

(3) Connect ignition coil cable to ignition coil.

IGNITION COIL—3.9/5.2/5.9L ENGINES

The ignition coil is an epoxy filled type. If the coil is replaced, it must be replaced with the same type.

REMOVAL

The coil is mounted to a bracket that is bolted to the front of the right engine cylinder head (Fig. 29). This bracket is mounted on top of the automatic belt tensioner bracket using common bolts.

(1) Disconnect the primary wiring from the ignition coil.

(2) Disconnect the secondary spark plug cable from the ignition coil.

WARNING: DO NOT REMOVE THE COIL MOUNTING BRACKET-TO-CYLINDER HEAD MOUNTING BOLTS. THE COIL MOUNTING BRACKET IS UNDER ACCESSORY DRIVE BELT TENSION. IF THIS BRACKET IS TO BE REMOVED FOR ANY REASON, ALL BELT TENSION MUST FIRST BE RELIEVED. REFER TO THE BELT SECTION OF GROUP 7, COOLING SYSTEM.

REMOVAL AND INSTALLATION (Continued)

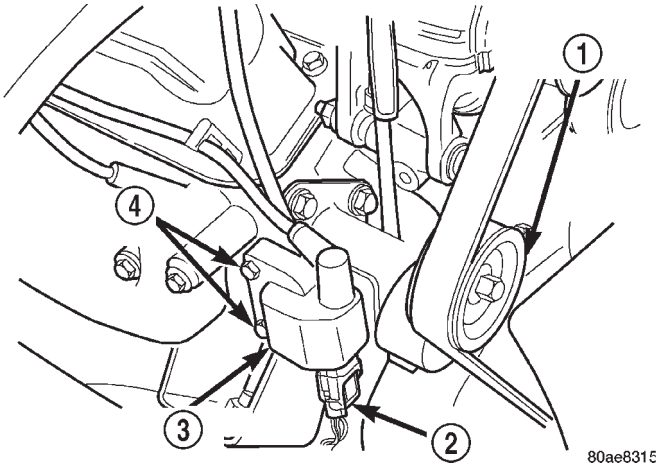


Fig. 29 Ignition Coil—3.9L V-6 or 5.2/5.9L V-8 Engines

1 – ACCESSORY DRIVE BELT TENSIONER
2 – COIL CONNECTOR
3 – IGNITION COIL
4 – COIL MOUNTING BOLTS

(3) Remove ignition coil from coil mounting bracket (two bolts).

INSTALLATION

(1) Install the ignition coil to coil bracket. If nuts and bolts are used to secure coil to coil bracket, tighten to 11 N·m (100 in. lbs.) torque. If the coil mounting bracket has been tapped for coil mounting bolts, tighten bolts to 5 N·m (50 in. lbs.) torque.

(2) Connect all wiring to ignition coil.

IGNITION COIL—4.7L ENGINE

REMOVAL

An individual ignition coil is used for each spark plug (Fig. 30). The coil fits into machined holes in the cylinder head. A mounting stud/nut secures each coil to the top of the intake manifold (Fig. 31). The bottom of the coil is equipped with a rubber boot to seal the spark plug to the coil. Inside each rubber boot is a spring. The spring is used for a mechanical contact between the coil and the top of the spark plug. These rubber boots and springs are a permanent part of the coil and are not serviced separately. An o-ring (Fig. 30) is used to seal the coil at the opening into the cylinder head.

(1) Depending on which coil is being removed, the throttle body air intake tube or intake box may need to be removed to gain access to coil.

(2) Disconnect electrical connector (Fig. 31) from coil by pushing downward on release lock on top of connector and pull connector from coil.

(3) Clean area at base of coil with compressed air before removal.

(4) Remove coil mounting nut from mounting stud (Fig. 31).

(5) Carefully pull up coil from cylinder head opening with a slight twisting action.

(6) Remove coil from vehicle.

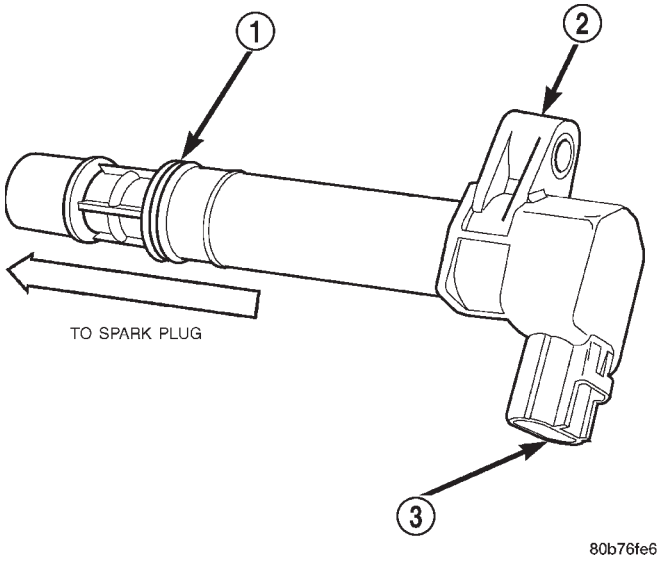


Fig. 30 Ignition Coil—4.7L V–8 Engine

1 – O-RING
2 – IGNITION COIL
3 – ELECTRICAL CONNECTOR

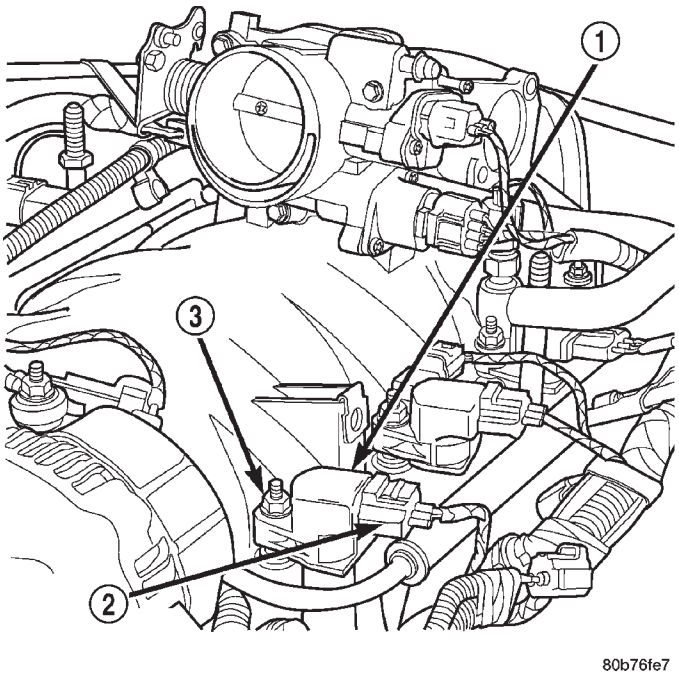


Fig. 31 Ignition Coil Location—4.7L V–8 Engine

1 – IGNITION COIL
2 – COIL ELECTRICAL CONNECTOR
3 – COIL MOUNTING STUD/NUT

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Using compressed air, blow out any dirt or contaminants from around top of spark plug.

(2) Check condition of coil o-ring and replace as necessary. To aid in coil installation, apply silicone to coil o-ring.

(3) Position ignition coil into cylinder head opening and push onto spark plug. Do this while guiding coil base over mounting stud.

(4) Install mounting stud nut and tighten to 8 N·m (70 in. lbs.) torque.

(5) Connect electrical connector to coil by snapping into position.

(6) If necessary, install throttle body air tube or box.

CRANKSHAFT POSITION SENSOR—2.5L ENGINE

The crankshaft position sensor is mounted in the transmission bellhousing at left/rear side of engine block (Fig. 32).

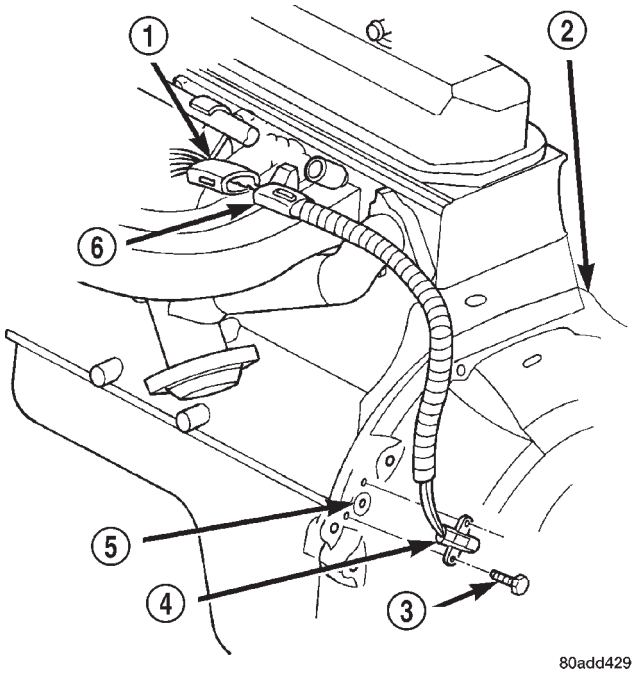


Fig. 32 Crankshaft Position Sensor—2.5L 4-Cylinder Engine

1 – ELECTRICAL CONNECTOR
2 – TRANSMISSION BELLHOUSING
3 – MOUNTING BOLTS (2)
4 – CRANKSHAFT POSITION SENSOR
5 – RUBBER GROMMET
6 – PIGTAIL HARNESS

REMOVAL

(1) Remove air tube between throttle body and air cleaner housing.

(2) Near rear of intake manifold, disconnect pigtail harness (on the sensor) from main electrical harness.

(3) Remove 2 sensor mounting bolts.

(4) Remove sensor.

(5) Remove clip from sensor wire harness.

INSTALLATION

(1) Install sensor flush against opening in transmission housing.

(2) Install and tighten two sensor mounting bolts to 19 N·m (14 ft. lbs.) torque.

CAUTION: Two bolts are used to secure the sensor to transmission. These bolts are specially machined to correctly space the unit to flywheel. Do not attempt to install any other bolts.

(3) Connect electrical connector to sensor.

(4) Install clip on sensor wire harness.

(5) Install air tube between throttle body and air cleaner housing.

CRANKSHAFT POSITION SENSOR—3.9/5.2/ 5.9L ENGINES

REMOVAL

The sensor is bolted to the top of the cylinder block near the rear of right cylinder head (Fig. 33). The sensor is accessed by removing the right front fender liner.

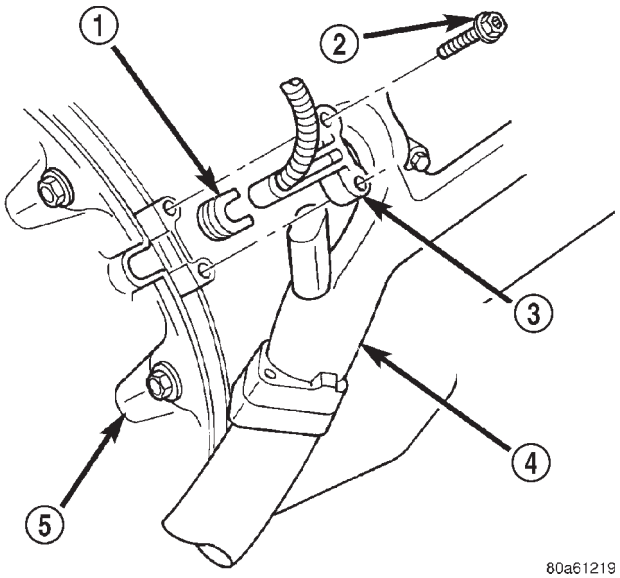


Fig. 33 Crankshaft Position Sensor—3.9/5.2/5.9L Engines

1 – GROMMET
2 – MOUNTING BOLTS (2)
3 – CRANKSHAFT POSITION SENSOR
4 – RIGHT EXHAUST MANIFOLD
5 – TRANSMISSION BELL HOUSING

REMOVAL AND INSTALLATION (Continued)

(1) Remove right front tire and right front wheelhouse liner. Refer to Front Wheelhouse Liner in Group 23, Body.
(2) Disconnect crankshaft position sensor pigtail harness from main wiring harness.
(3) Remove two sensor (recessed hex head) mounting bolts (Fig. 33).
(4) Remove sensor from engine.

INSTALLATION

(1) Position crankshaft position sensor to engine.
(2) Install mounting bolts and tighten to 8 N·m (70 in. lbs.) torque.
(3) Connect main harness electrical connector to sensor.
(4) Install right front tire and right front wheelhouse liner. Refer to Front Wheelhouse Liner in Group 23, Body.

CRANKSHAFT POSITION SENSOR—4.7L V-8 ENGINE

REMOVAL

The Crankshaft Position (CKP) sensor is located at the right-rear side of the engine cylinder block (Fig. 34). It is positioned and bolted into a machined hole in the engine block.

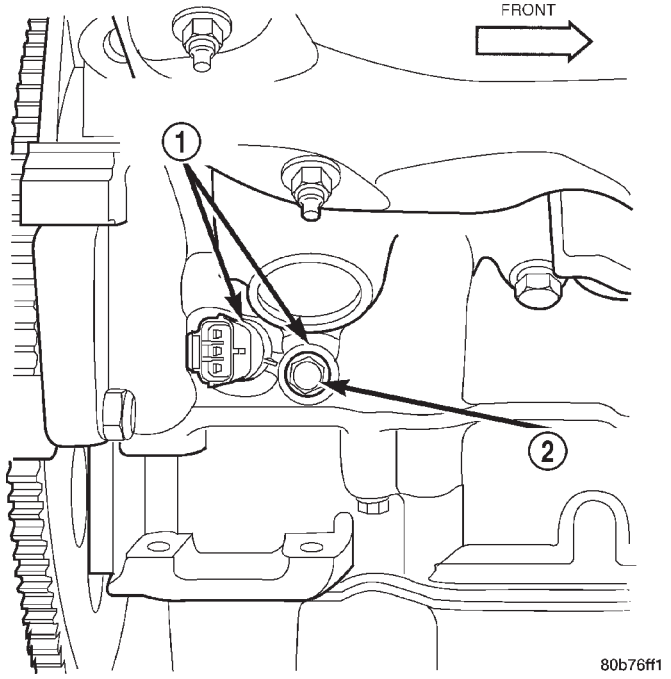


Fig. 34 CKP Sensor Location/Removal/Installation—4.7L V–8 Engine

1 – CRANKSHAFT POSITION SENSOR
2 – MOUNTING BOLT

(1) Disconnect CKP electrical connector at sensor.
(2) Remove CKP mounting bolt (Fig. 34).
(3) Carefully pry sensor from cylinder block in a rocking action with two small screwdrivers.
(4) Remove sensor from vehicle.
(5) Check condition of sensor o-ring.

INSTALLATION

(1) Clean out machined hole in engine block.
(2) Apply a small amount of engine oil to sensor o-ring.
(3) Install sensor into engine block with a slight rocking action. Do not twist sensor into position as damage to o-ring may result.

CAUTION: Before tightening sensor mounting bolt, be sure sensor is completely flush to cylinder block. If sensor is not flush, damage to sensor mounting tang may result.

(4) Install mounting bolt and tighten to 28 N·m (21 ft. lbs.) torque.
(5) Connect electrical connector to sensor.

CAMSHAFT POSITION SENSOR

The camshaft position sensor is located in the distributor on all 2.5/3.9/5.2/5.9L engines (Fig. 35).

REMOVAL

Distributor removal is not necessary to remove camshaft position sensor.

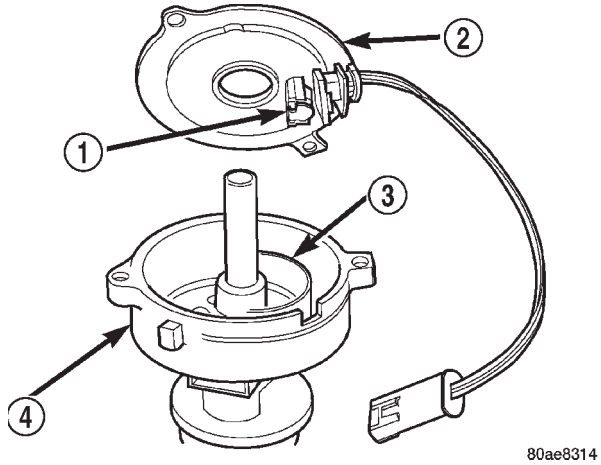


Fig. 35 Camshaft Position Sensor—Typical (3.9/5.2/5.9L Shown)

1 – SYNC SIGNAL GENERATOR
2 – CAMSHAFT POSITION SENSOR
3 – PULSE RING
4 – DISTRIBUTOR ASSEMBLY

(1) Remove air cleaner assembly.
(2) Disconnect negative cable from battery.
(3) Remove distributor cap from distributor (two screws).

REMOVAL AND INSTALLATION (Continued)

(4) Disconnect camshaft position sensor wiring harness from main engine wiring harness.
(5) Remove distributor rotor from distributor shaft.
(6) Lift the camshaft position sensor assembly from the distributor housing (Fig. 35).

INSTALLATION

(1) Install camshaft position sensor to distributor. Align sensor into notch on distributor housing.
(2) Connect wiring harness.
(3) Install rotor.
(4) Install distributor cap. Tighten mounting screws.
(5) Install air cleaner assembly.

CAMSHAFT POSITION SENSOR—4.7L ENGINE

The Camshaft Position Sensor (CMP) on the 4.7L V–8 engine is bolted to the front/top of the right cylinder head (Fig. 36).

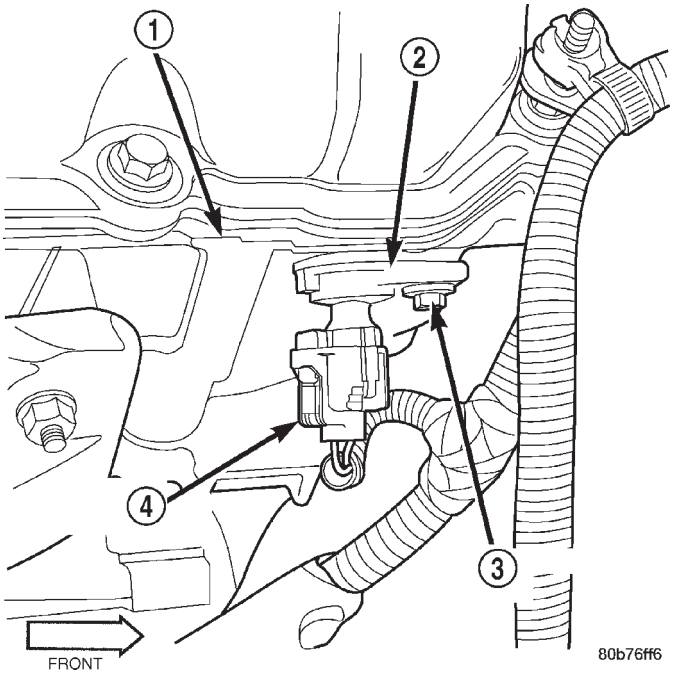


Fig. 36 CMP Location—4.7L Engine

1 – RIGHT CYLINDER HEAD
2 – CAMSHAFT POSITION SENSOR
3 – MOUNTING BOLT
4 – ELEC. CONNECTOR

REMOVAL

It is easier to remove/install sensor from under vehicle.
(1) Raise and support vehicle.
(2) Disconnect electrical connector at CMP sensor (Fig. 36).
(3) Remove sensor mounting bolt (Fig. 36).
(4) Carefully pry sensor from cylinder head in a rocking action with two small screwdrivers.
(5) Check condition of sensor o-ring.

INSTALLATION

(1) Clean out machined hole in cylinder head.
(2) Apply a small amount of engine oil to sensor o-ring.
(3) Install sensor into cylinder head with a slight rocking action. Do not twist sensor into position as damage to o-ring may result.

CAUTION: Before tightening sensor mounting bolt, be sure sensor is completely flush to cylinder head. If sensor is not flush, damage to sensor mounting tang may result.

(4) Install mounting bolt and tighten to 12 N·m (106 in. lbs.) torque.
(5) Connect electrical connector to sensor.
(6) Lower vehicle.

DISTRIBUTOR—2.5L ENGINE

The distributor contains an internal oil seal that prevents oil from entering the distributor housing. The seal is not serviceable.

Factory replacement distributors are equipped with a plastic alignment pin already installed. The pin is located in an access hole on the bottom of the distributor housing (Fig. 37). It is used to temporarily lock the rotor to the cylinder number 1 position during installation. The pin must be removed after installing distributor.

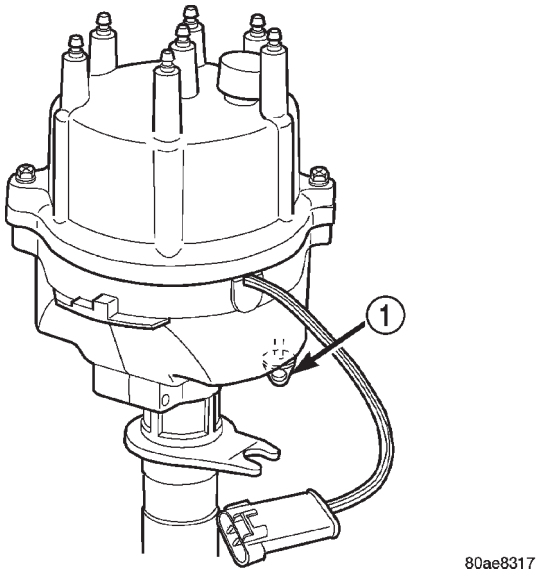


Fig. 37 Plastic Alignment Pin

1 – PLASTIC ALIGNMENT PIN

The camshaft position sensor is located in the distributor on all engines (Fig. 38). For removal/installation procedures, refer to Camshaft Position Sensor.

REMOVAL AND INSTALLATION (Continued)

Distributor removal is not necessary for sensor removal.

Refer to (Fig. 38) for an exploded view of the distributor.

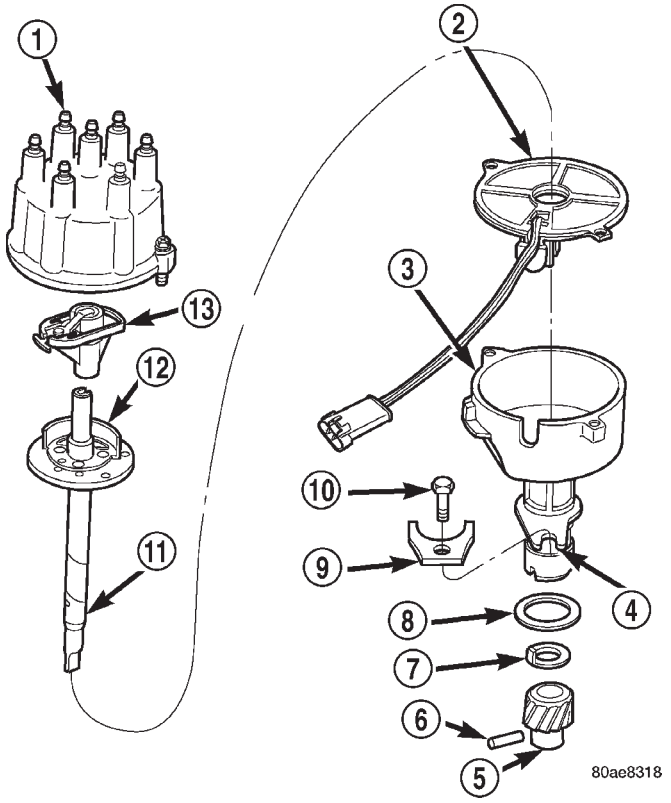


Fig. 38 Distributor—2.5L Engine—Typical

1 – CAP
2 – CAMSHAFT POSITION SENSOR
3 – HOUSING
4 – FORK WITH SLOT
5 – DRIVE GEAR
6 – ROLL PIN
7 – WASHER
8 – GASKET
9 – HOLDDOWN CLAMP
10 – HOLDDOWN BOLT
11 – SHAFT
12 – PULSE RING
13 – ROTOR

A fork with a slot is supplied on the bottom of the distributor housing where the housing base seats against the engine block (Fig. 38). The centerline of the slot aligns with the distributor holddown bolt hole in the engine block. Because of the fork, the distributor cannot be rotated. Distributor rotation is not necessary as all ignition timing requirements are handled by the powertrain control module (PCM).

The position of the distributor determines fuel synchronization only. It does not determine ignition timing.

NOTE: Do not attempt to modify this fork to attain ignition timing.

REMOVAL

(1) Disconnect negative battery cable at battery.

(2) Remove air tube between throttle body and air cleaner housing.

(3) Disconnect coil secondary cable at coil.

(4) Remove distributor cap from distributor (2 screws). Do not remove cables from cap. Do not remove rotor.

(5) Disconnect distributor wiring harness from main engine harness.

(6) Remove cylinder number 1 spark plug.

(7) Hold a finger over open spark plug hole. Rotate engine at vibration dampener bolt until compression (pressure) is felt.

(8) Slowly continue to rotate engine. Do this until timing index mark on vibration damper pulley aligns with top dead center (TDC) mark (0 degree) on timing degree scale (Fig. 39). Always rotate engine in direction of normal rotation. Do not rotate engine backward to align timing marks.

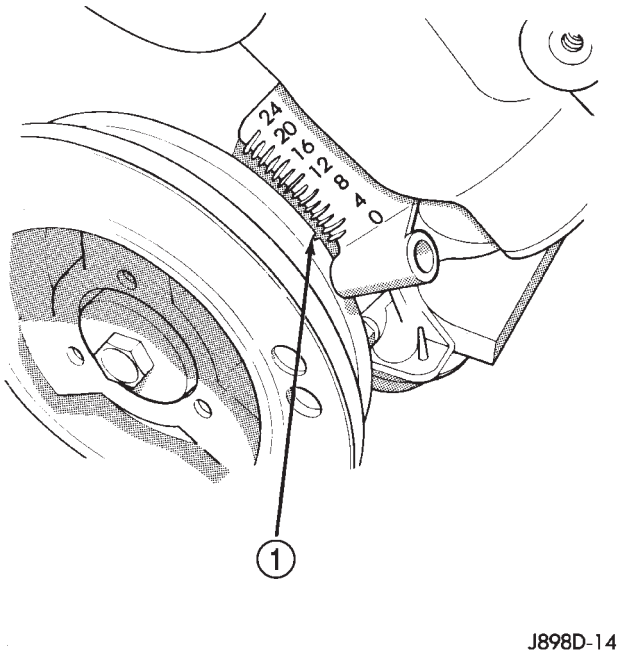


Fig. 39 Align Timing Marks

1 – CRANKSHAFT VIBRATION DAMPER TIMING MARK

(9) Remove distributor holddown bolt and clamp.

(10) Remove distributor from engine by slowly lifting straight up.

(11) Note that rotor will rotate slightly in a counterclockwise direction while lifting up distributor. The oil pump gear will also rotate slightly in a counterclockwise direction while lifting up distributor.

REMOVAL AND INSTALLATION (Continued)

This is due to the helical cut gears on distributor and camshaft.

(12) Note removed position of rotor during distributor removal. During installation, this will be referred to as the Pre-position.

(13) Observe slot in oil pump gear through hole on side of engine. It should be slightly before (counterclockwise of) 10 o'clock position (Fig. 40).

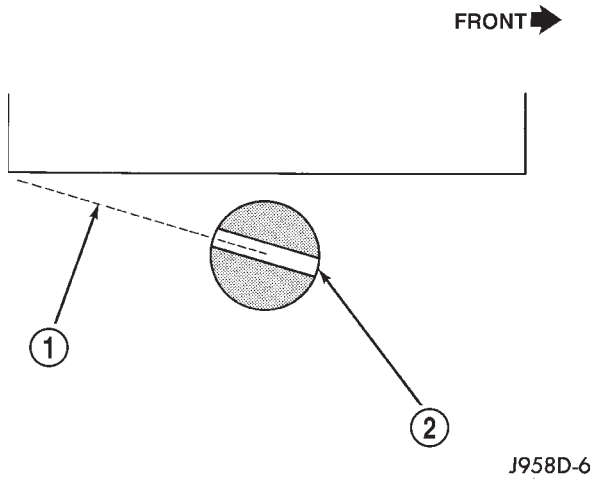


Fig. 40 Slot At 10 O'clock Position—2.5L Engine

1 – 10 0'CLOCK POSITION
2 – OIL PUMP SLOT

(14) Remove and discard the old distributor-to-engine block gasket.

INSTALLATION

(1) If engine crankshaft has been rotated after distributor removal, cylinder number 1 must be returned to its proper firing stroke. Refer to previous REMOVAL Step 6 and Step 7. These steps must be done before installing distributor.

(2) Check position of slot on oil pump gear. It should be just slightly before (counterclockwise of) 10 o'clock position (Fig. 40). If not, place a flat blade screwdriver into oil pump gear and rotate it into proper position.

(3) Factory replacement distributors are equipped with a plastic alignment pin already installed (Fig. 37). This pin is used to temporarily hold rotor to cylinder number 1 firing position during distributor installation. If this pin is in place, proceed to Step 8. If not, proceed to next step.

(4) If original distributor is to be reinstalled, such as during engine overhaul, the plastic pin will not be available. A 3/16 inch drift pin punch tool may be substituted for plastic pin.

(5) Remove camshaft position sensor from distributor housing. Lift straight up.

(6) Four different alignment holes are provided on the plastic ring (Fig. 41). **Note that 2.5L 4–cylinder and 4.0L 6–cylinder engines have different alignment holes (Fig. 41).**

(7) Rotate distributor shaft and install pin punch tool through proper alignment hole in plastic ring (Fig. 41) and into mating access hole in distributor housing. This will prevent distributor shaft and rotor from rotating.

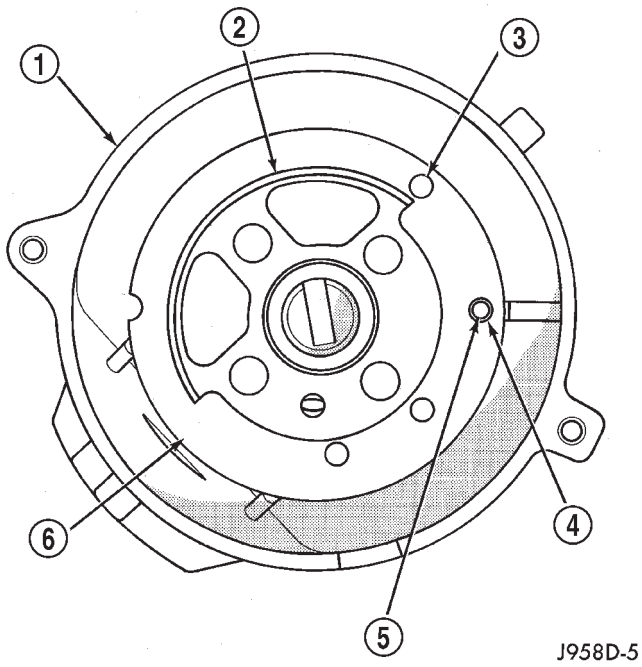


Fig. 41 Pin Alignment Holes

1 – DISTRIBUTOR HOUSING (TOP VIEW)
2 – PULSE RING
3 – 4.0L 6–CYLINDER ENGINE ALIGN. HOLE
4 – 2.5L 4–CYLINDER ENGINE ALIGN. HOLE
5 – MATING ACCESS HOLE IN DISTRIBUTOR HOUSING
6 – PLASTIC RING

(8) Clean distributor mounting hole area of engine block.

(9) Install new distributor-to-engine block gasket (Fig. 38).

(10) Install rotor to distributor shaft.

(11) Pre-position distributor into engine while holding centerline of base slot in 1 o'clock position (Fig. 42). Continue to engage distributor into engine. The rotor and distributor will rotate clockwise during installation. This is due to helical cut gears on distributor and camshaft. When distributor is fully seated to engine block, the centerline of base slot should be aligned to clamp bolt mounting hole on engine (Fig. 43). The rotor should also be pointed slightly past (clockwise of) 3 o'clock position.

It may be necessary to rotate rotor and distributor shaft (very slightly) to engage distributor shaft with slot in oil pump gear. The same may have to be done to engage distributor gear with camshaft gear.

REMOVAL AND INSTALLATION (Continued)

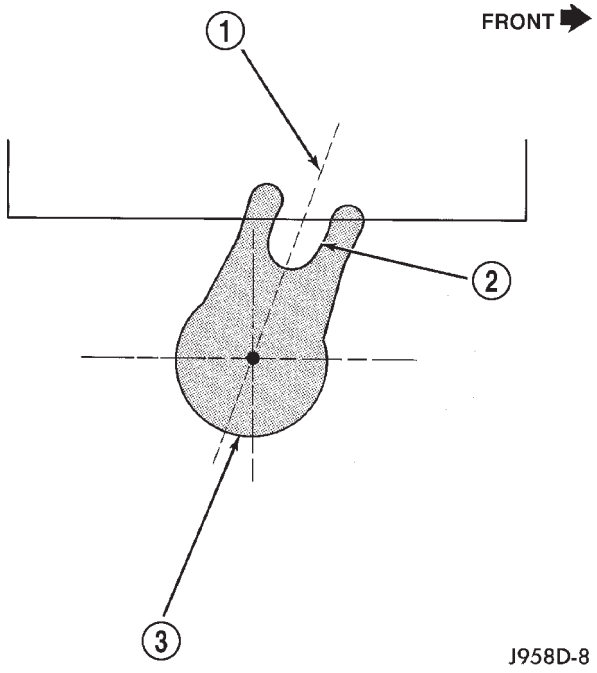


Fig. 42 Distributor Pre-position

1 – 1 O'CLOCK POSITION
2 – BASE SLOT
3 – DISTRIBUTOR BASE

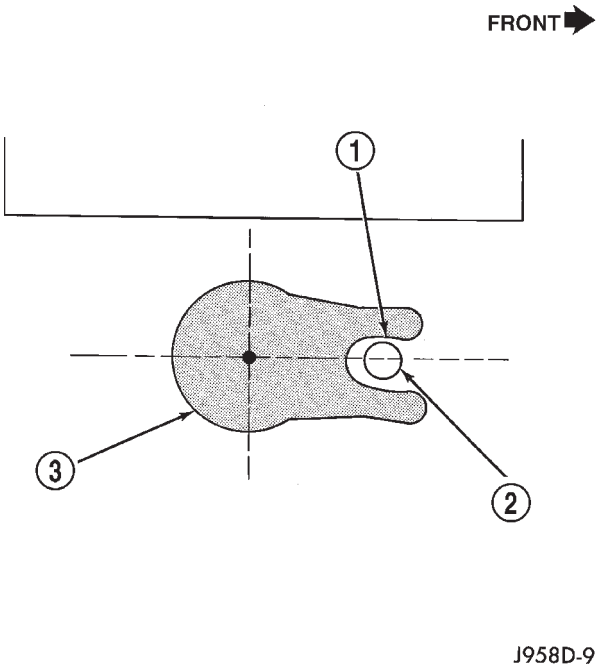


Fig. 43 Distributor Engaged Position—2.5L 4-Cylinder Engine

1 – DISTRIBUTOR BASE SLOT
2 – CLAMP BOLT MOUNTING HOLE (ON ENGINE)
3 – DISTRIBUTOR BASE

The distributor is correctly installed when:

- rotor is pointed at the 3 o'clock position
- plastic alignment pin (or pin punch tool) is still installed to distributor.
- number 1 cylinder piston is set at top dead center (TDC) (compression stroke).
- centerline of slot at base of distributor is aligned to centerline of distributor holddown bolt hole on engine. In this position, holddown bolt should easily pass through slot and into engine.

No adjustments are necessary. Proceed to next step.

(12) Install distributor holddown clamp and bolt. Tighten bolt to 23 N·m (17 ft. lbs.) torque.

(13) Remove pin punch tool from distributor. Or, if plastic alignment pin was used, remove it straight down from bottom of distributor. Discard plastic pin.

(14) If removed, install camshaft position sensor to distributor. Align wiring harness grommet to notch in distributor housing.

(15) Install rotor.

CAUTION: If the distributor cap is incorrectly positioned on distributor housing, the cap or rotor may be damaged when engine is started.

(16) Install distributor cap. Tighten distributor cap holddown screws to 3 N·m (26 in. lbs.) torque.

(17) If removed, install spark plug cables to distributor cap. For proper firing order, refer to Specifications section at end of this group. See Engine Firing Order.

(18) Connect distributor wiring harness to main engine harness.

(19) Connect air tube between throttle body and air cleaner housing.

(20) Connect battery cable to battery.

DISTRIBUTORS—3.9/5.2/5.9L ENGINES

REMOVAL

CAUTION: Base ignition timing is not adjustable on any engine. Distributors do not have built in centrifugal or vacuum assisted advance. Base ignition timing and timing advance are controlled by the Powertrain Control Module (PCM). Because a conventional timing light can not be used to adjust distributor position after installation, note position of distributor before removal.

(1) Remove air cleaner assembly.

(2) Disconnect negative cable from battery.

(3) Remove distributor cap from distributor (two screws).

(4) Mark the position of distributor housing in relationship to engine or dash panel. This is done to aid in installation.

REMOVAL AND INSTALLATION (Continued)

(5) Before distributor is removed, the number one cylinder must be brought to the Top Dead Center (TDC) firing position.

(6) Attach a socket to the Crankshaft Vibration Damper mounting bolt.

(7) Slowly rotate engine clockwise, as viewed from front, until indicating mark on crankshaft vibration damper is aligned to 0 degree (TDC) mark on timing chain cover (Fig. 44).

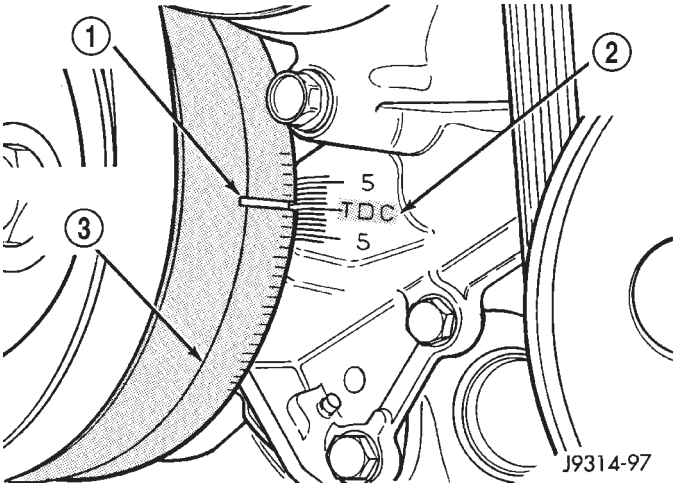


Fig. 44 Damper-To-Cover Alignment Marks—Typical

1 – ALIGNMENT MARK
2 – TIMING CHAIN COVER MARKS
3 – CRANKSHAFT VIBRATION DAMPER

(8) The distributor rotor should now be aligned to the CYL. NO. 1 alignment mark (stamped) into the camshaft position sensor (Fig. 45). If not, rotate the crankshaft through another complete 360 degree turn. Note the position of the number one cylinder spark plug cable (on the cap) in relation to rotor. Rotor should now be aligned to this position.

(9) Disconnect camshaft position sensor wiring harness from main engine wiring harness.

(10) Remove distributor rotor from distributor shaft.

(11) Remove distributor holddown clamp bolt and clamp (Fig. 46). Remove distributor from vehicle.

CAUTION: Do not crank engine with distributor removed. Distributor/crankshaft relationship will be lost.

INSTALLATION

If engine has been cranked while distributor is removed, establish the relationship between distributor shaft and number one piston position as follows:

Rotate crankshaft in a clockwise direction, as viewed from front, until number one cylinder piston is at top of compression stroke (compression should be felt on finger with number one spark plug removed). Then continue to slowly rotate engine clockwise until indicating mark (Fig. 44) is aligned to 0 degree (TDC) mark on timing chain cover.

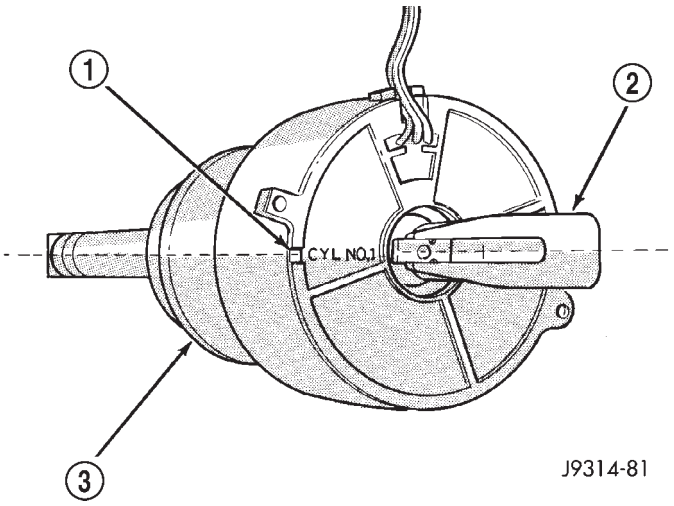


Fig. 45 Rotor Alignment Mark—3.9/5.2/5.9L Engines

1 – CAMSHAFT POSITION SENSOR ALIGNMENT MARK
2 – ROTOR
3 – DISTRIBUTOR

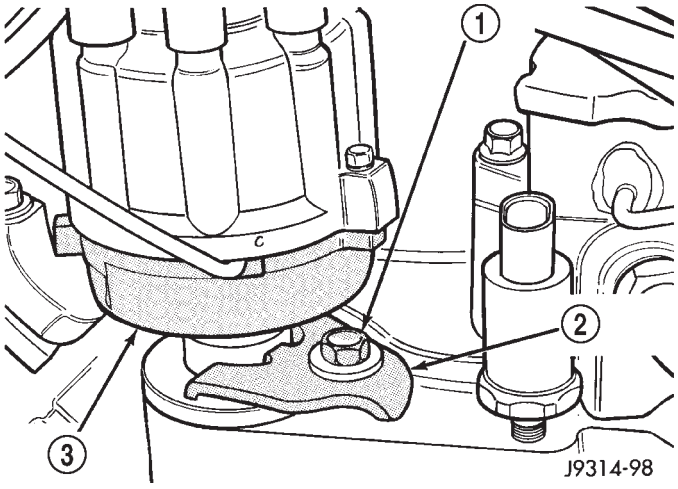


Fig. 46 Distributor Holddown Clamp—3.9/5.2/5.9L Engines

1 – CLAMP BOLT
2 – HOLDDOWN CLAMP
3 – DISTRIBUTOR HOUSING

(1) Clean top of cylinder block for a good seal between distributor base and block.

(2) Lightly oil the rubber o-ring seal on the distributor housing.

(3) Install rotor to distributor shaft.

(4) Position distributor into engine to its original position. Engage tongue of distributor shaft with slot

REMOVAL AND INSTALLATION (Continued)

in distributor oil pump drive gear. Position rotor to the number one spark plug cable position.

(5) Install distributor holddown clamp and clamp bolt. Do not tighten bolt at this time.

(6) Rotate the distributor housing until rotor is aligned to CYL. NO. 1 alignment mark on the camshaft position sensor (Fig. 45).

(7) Tighten clamp holddown bolt (Fig. 46) to 22.5 N·m (200 in. lbs.) torque.

(8) Connect camshaft position sensor wiring harness to main engine harness.

(9) Install distributor cap. Tighten mounting screws.

(10) Refer to the following, Checking Distributor Position.

CHECKING DISTRIBUTOR POSITION

To verify correct distributor rotational position, the DRB scan tool must be used.

WARNING: WHEN PERFORMING THE FOLLOWING TEST, THE ENGINE WILL BE RUNNING. BE CAREFUL NOT TO STAND IN LINE WITH THE FAN BLADES OR FAN BELT. DO NOT WEAR LOOSE CLOTHING.

(1) Connect DRB scan tool to data link connector. The data link connector is located in passenger compartment, below and to left of steering column.

(2) Gain access to SET SYNC screen on DRB.

(3) Follow directions on DRB screen and start engine. Bring to operating temperature (engine must be in “closed loop” mode).

(4) With engine running at **idle speed**, the words IN RANGE should appear on screen along with 0°. This indicates correct distributor position.

(5) If a plus (+) or a minus (-) is displayed next to degree number, and/or the degree displayed is not zero, loosen but do not remove distributor holddown clamp bolt. Rotate distributor until IN RANGE appears on screen. Continue to rotate distributor until achieving as close to 0° as possible. After adjustment, tighten clamp bolt to 22.5 N·m (200 in. lbs.) torque.

The degree scale on SET SYNC screen of DRB is referring to fuel synchronization only. **It is not referring to ignition timing.** Because of this, do not attempt to adjust ignition timing using this method. Rotating distributor will have no effect on ignition timing. All ignition timing values are controlled by powertrain control module (PCM).

After testing, install air cleaner assembly.

IGNITION SWITCH AND KEY CYLINDER

The ignition key must be in the key cylinder for cylinder removal.

KEY CYLINDER REMOVAL

(1) Disconnect negative cable from battery.

(2) If equipped with tilt column, remove tilt lever by turning it counterclockwise.

(3) Remove upper and lower covers (shrouds) from steering column (Fig. 47).

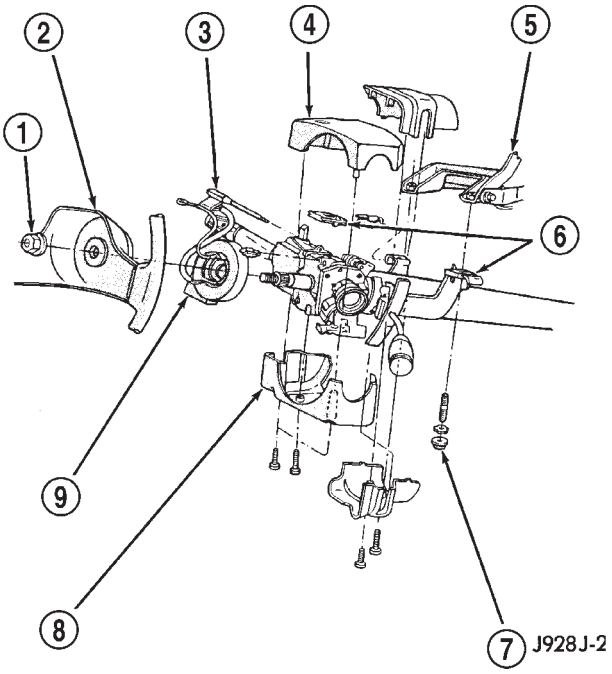


Fig. 47 Shroud Removal/Installation—Typical

1 – NUT
2 – STEERING WHEEL
3 – TILT LEVER
4 – UPPER SHROUD
5 – PANEL BRACKET
6 – SPACER
7 – NUT
8 – LOWER SHROUD
9 – CLOCK SPRING

(4) If equipped with automatic transmission, place shifter in PARK position.

(5) A retaining pin (Fig. 48) is located at side of key cylinder assembly.

(a) Rotate key to RUN position.

(b) Press in on retaining pin while pulling key cylinder from ignition switch.

IGNITION SWITCH REMOVAL

(1) Remove key lock cylinder. Refer to previous steps.

(2) Remove 3 ignition switch mounting screws (Fig. 49). Use tamper proof torx bit (Snap-On® SDMTR10 or equivalent) to remove screws.

(3) Gently pull switch away from column. Release connector locks on 7-terminal wiring connector at ignition switch and remove connector (Fig. 50).

REMOVAL AND INSTALLATION (Continued)

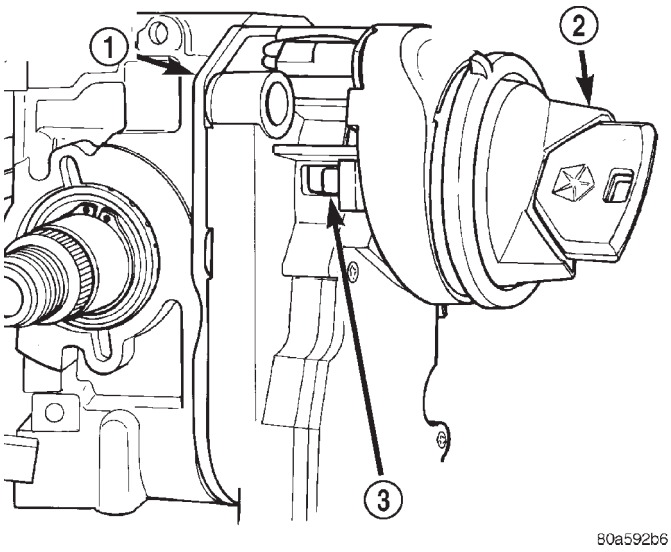


Fig. 48 Retaining Pin

1 – IGNITION SWITCH
2 – KEY/KEY CYLINDER (RUN POSITION)
3 – RETAINING PIN

(4) Release connector lock on 4-terminal halo lamp wiring connector and remove connector (Fig. 50).

(5) Disconnect electronic "PRNDL" from switch (if equipped).

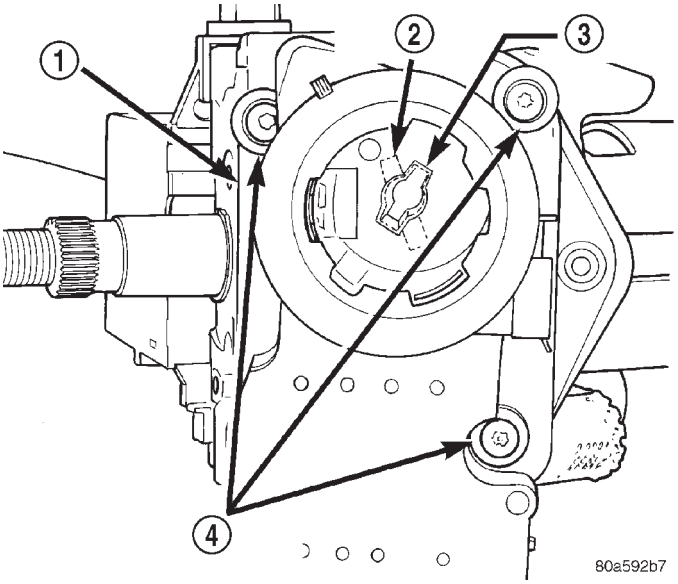


Fig. 49 Switch Mounting Screws

1 – IGNITION SWITCH
2 – SLOTS NOT ALIGNED
3 – SLOTS ALIGNED
4 – IGNITION SWITCH MOUNTING SCREWS (3)

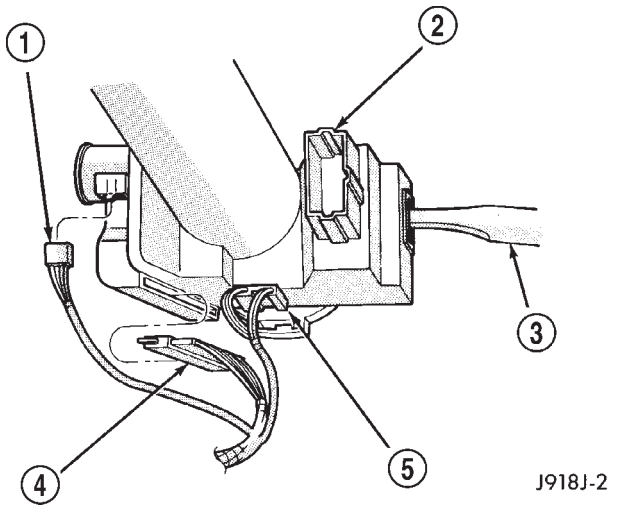


Fig. 50 Ignition Switch and Halo Lamp Connectors

1 – KEY-IN SWITCH & HALO LIGHT
2 – MULTI-FUNCTION SWITCH
3 – TURN SIGNAL SWITCH & LEVER
4 – IGNITION SWITCH
5 – SPEED CONTROL

IGNITION SWITCH AND KEY CYLINDER INSTALLATION

If installing **ignition key lock cylinder only,** proceed to following steps 2, 3 and 4. Also refer to following steps 12 through 18. If installing both switch and key cylinder, refer to steps 1 through 18.

(1) Rotate flag (Fig. 51) on rear of ignition switch until in RUN position. This step must be done to allow tang (Fig. 52) on key cylinder to fit into slots (Fig. 49) within ignition switch.

(2) With key into ignition key cylinder, rotate key clockwise until retaining pin can be depressed (Fig. 52) or (Fig. 53).

(3) Install key cylinder into ignition switch by aligning retaining pin into retaining pin slot (Fig. 53). Push key cylinder into switch until retaining pin engages. After pin engages, rotate key to OFF or LOCK position.

(4) Check for proper retention of key cylinder by attempting to pull cylinder from switch.

(5) Automatic Transmission Only: Before attaching ignition switch to steering column, the transmission shifter must be in PARK position. The park lock dowel pin on rear of ignition switch (Fig. 54) must also be properly indexed into the park lock linkage (Fig. 55) before installing switch.

(6) The flag at rear of ignition switch (Fig. 54) must be properly indexed into steering column before installing switch. This flag is used to operate the steering wheel lock lever in steering column (Fig. 56). This lever allows steering wheel position to be locked when key switch is in LOCK position.

REMOVAL AND INSTALLATION (Continued)

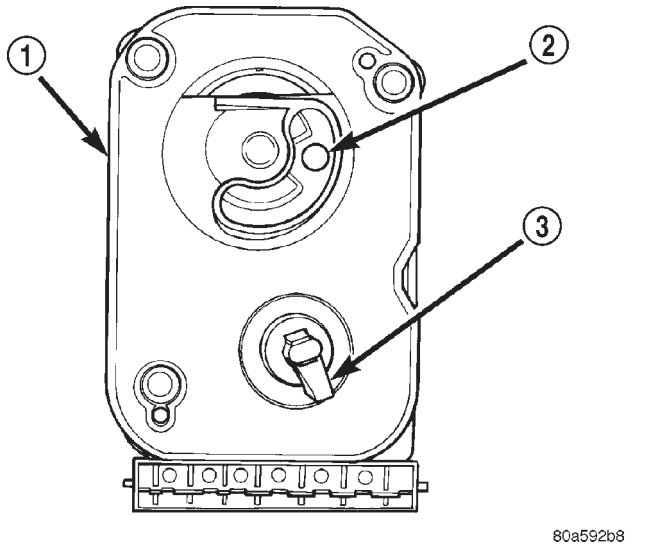


Fig. 51 Flag in RUN Position

1 – REAR OF IGNITION SWITCH
2 – PARK LOCK DOWEL PIN (RUN POSITION)
3 – FLAG (RUN POSITION)

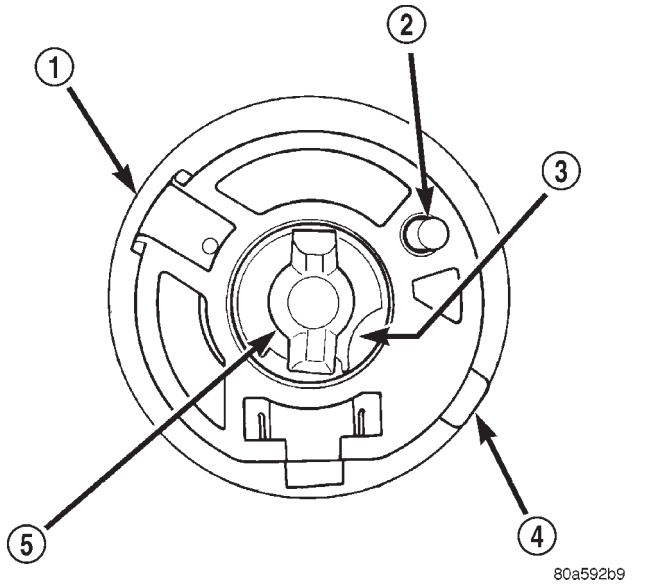


Fig. 52 Key Cylinder—Rear View

1 – IGNITION KEY LOCK CYLINDER
2 – PUSH PIN
3 – RETAINING PIN SLOT
4 – RETAINING PIN
5 – DRIVER

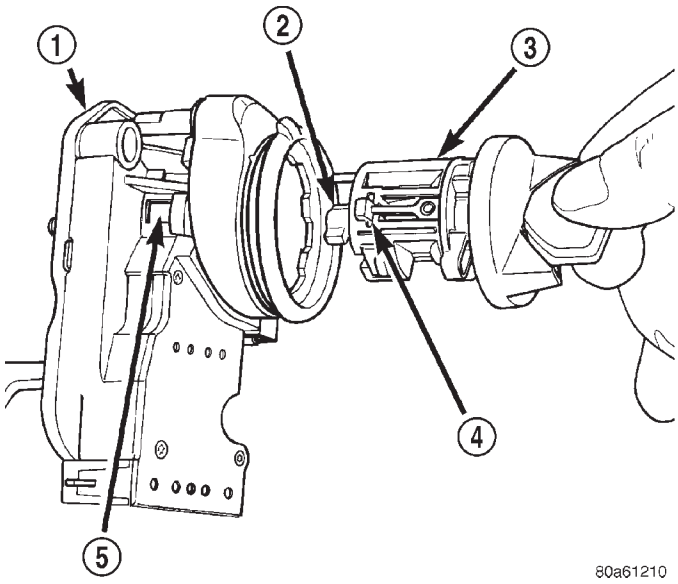


Fig. 53 Installing Key Cylinder Into Switch

1 – IGNITION SWITCH
2 – DRIVER
3 – IGNITION KEY LOCK CYLINDER
4 – RETAINING PIN
5 – RETAINING PIN SLOT

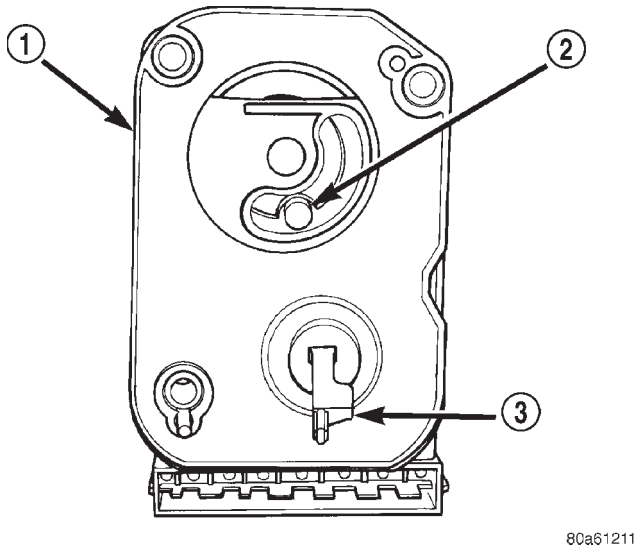


Fig. 54 Ignition Switch View From Column

1 – REAR OF IGNITION SWITCH
2 – PARK LOCK DOWEL PIN (LOCK POSITION)
3 – FLAG (LOCK POSITION)

(7) Place ignition switch in LOCK position. The switch is in the LOCK position when column lock flag is parallel to ignition switch terminals (Fig. 54).

(8) Automatic Transmission Only: Apply a light coating of grease to park lock dowel pin and park lock slider linkage. Before installing switch, push the park lock slider linkage (Fig. 55) forward until it bottoms. Do a final positioning by pulling it rearward about one-quarter inch.

(9) Apply a light coating of grease to both column lock flag and shaft at end of flag.

REMOVAL AND INSTALLATION (Continued)

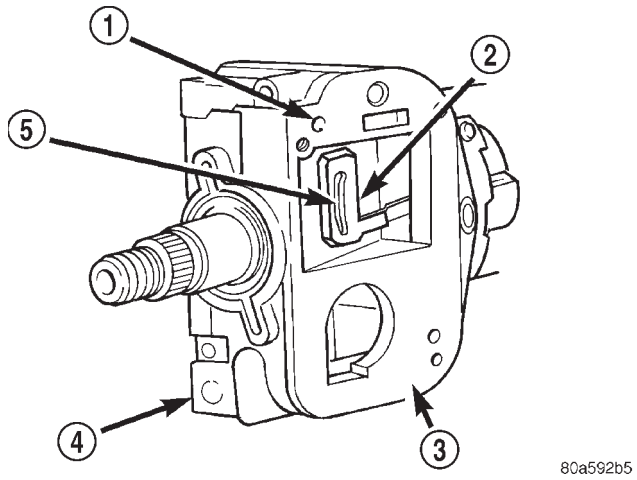


Fig. 55 Park Lock Linkage—Automatic Transmission—Typical

1 – DOWEL LOCATING HOLES (2)
2 – PARK LOCK SLIDER LINKAGE
3 – IGNITION SWITCH MOUNTING PAD
4 – STEERING COLUMN
5 – SLOT

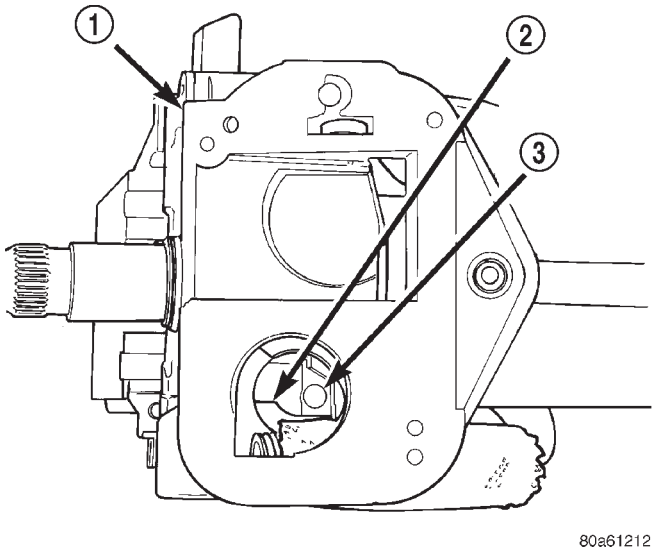


Fig. 56 Steering Wheel Lock Lever

1 – STEERING COLUMN
2 – STEERING WHEEL LOCK LEVER
3 – LOCATOR (SHAFT AT END OF FLAG)

(10) Place ignition switch into openings on steering column.

(a) Automatic Transmission Only: Be sure park lock dowel pin on rear of ignition switch enters slot in park lock slider linkage (Fig. 55).

(b) Be sure flag on rear of switch is positioned above steering wheel lock lever (Fig. 56).

(c) Align dowel pins on rear of switch into holes on side of steering column.

(d) Install 3 ignition switch mounting screws. Tighten screws to 2 N·m ±.5 N·m (17 in. lbs. ± 5 in. lbs.) torque.

(e) After installing ignition switch, rotate ignition key from LOCK to ON position. Verify that park lock slider moves in slider slot, allowing gearshift lever to be moved out of PARK (auto. trans. only). If slider does not move, and gearshift lever is locked in PARK, the ignition switch park lock dowel pin, on rear of ignition switch, is not properly installed in slot of park lock slider linkage. Remove ignition switch and reinstall.

(11) Connect electrical connectors to ignition switch, halo lamp and (if equipped), to “PRNDL”. Make sure that switch locking tabs are fully seated in wiring connectors.

(12) Install steering column covers (shrouds). Tighten screws to 2 N·m (17 in. lbs.) torque.

(13) Install tilt column lever (if equipped).

(14) Connect negative cable to battery.

(15) Check for proper operation of halo light.

(16) Automatic Transmission Only: Shifter should lock in PARK position when key is in LOCK position (if equipped with shift lock device). Shifter should unlock when key rotated to ON position.

(17) Check for proper operation of ignition switch in ACCESSORY, LOCK, OFF, ON, RUN, and START positions.

(18) Steering wheel should lock when key is in LOCK position. Rotate steering wheel at least 180° to verify. Steering wheel should unlock when key is rotated to ON position.

COLUMN SHIFT INTERLOCK

REMOVAL/INSTALLATION

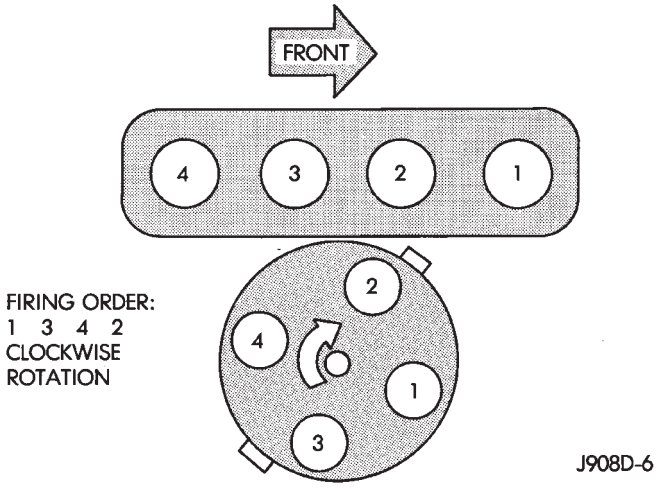
The column shift interlock is used to lock the transmission shifter in the Park position when the key is in the Off position. The interlock device is located within the steering column assembly and is not serviceable. If repair is necessary, the steering column assembly must be replaced. Refer to Group 19, Steering for procedures.

SPECIFICATIONS

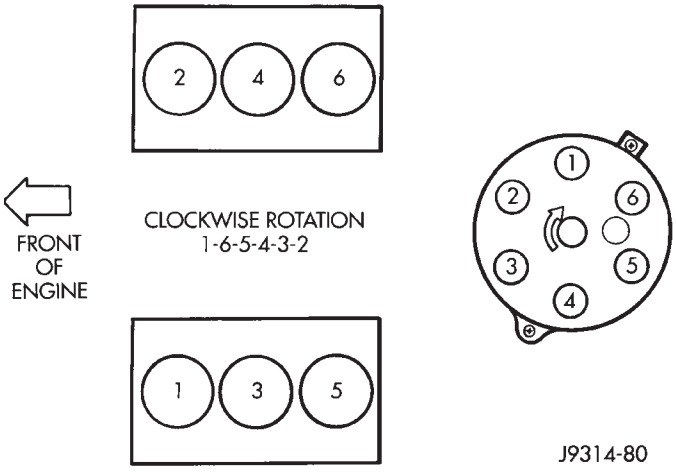
IGNITION TIMING

Ignition timing is not adjustable on any engine.

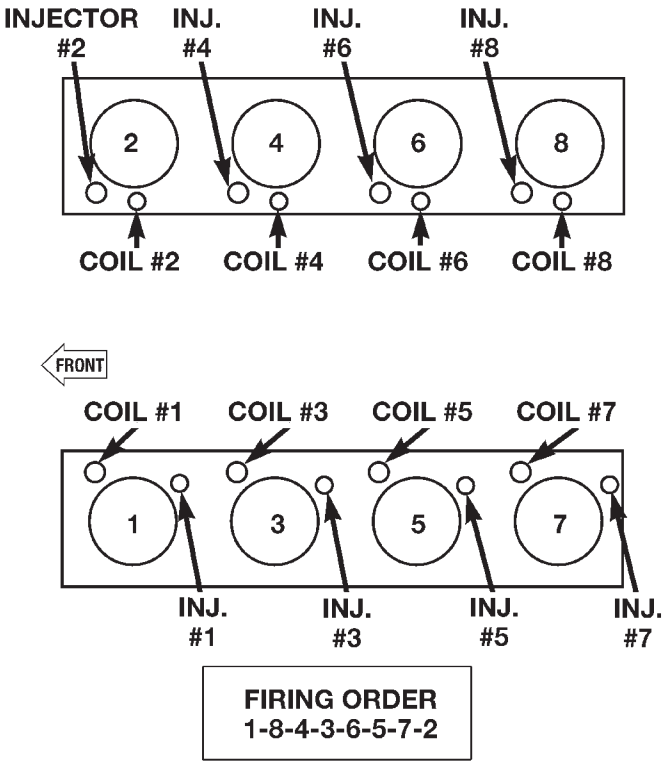
ENGINE FIRING ORDER—2.5L 4-CYLINDER ENGINE



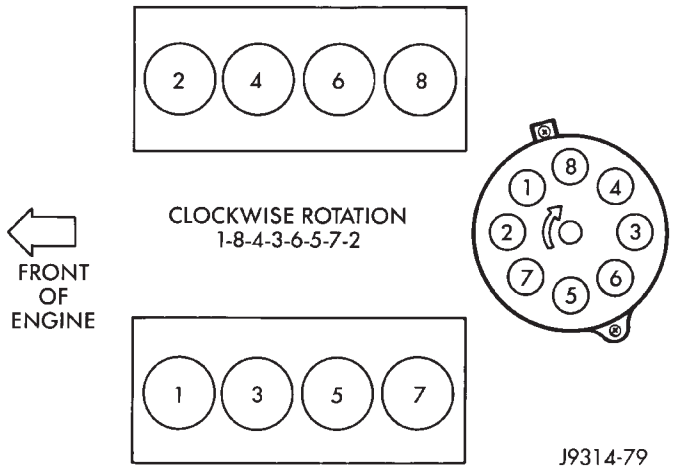
ENGINE FIRING ORDER—3.9L V-6 ENGINE



ENGINE FIRING ORDER—4.7L V-8 ENGINE



ENGINE FIRING ORDER—5.2L/5.9L V-8 ENGINES



SPECIFICATIONS (Continued)

SPARK PLUGS

ENGINE	PLUG TYPE	ELECTRODE GAP
2.5L 4-CYL.	RC12ECC	0.89 mm (.035 in.)
3.9L V-6	RC12LC4	1.01 mm (.040 in.)
4.7L V-8	RC12MCC4	1.01 mm (.040 in.)
5.2L V-8	RC12LC4	1.01 mm (.040 in.)
5.9L V-8	RC12LC4	1.01 mm (.040 in.)

SPARK PLUG CABLE RESISTANCE

MINIMUM	MAXIMUM
250 Ohms Per Inch	1000 Ohms Per Inch
3000 Ohms Per Foot	12,000 Ohms Per Foot

IGNITION COIL RESISTANCE—EXCEPT 4.7L ENGINE

COIL MANUFACTURER	PRIMARY RESISTANCE @ 21-27°C (70-80°F)	SECONDARY RESISTANCE @ 21-27°C (70-80°F)
Diamond	0.97 - 1.18 Ohms	11,300 - 15,300 Ohms
Toyodenso	0.95 - 1.20 Ohms	11,300 - 13,300 Ohms

IGNITION COIL RESISTANCE—4.7L V-8 ENGINE

PRIMARY RESISTANCE 21-27°C (70-80°F)	SECONDARY RESISTANCE 21-27°C (70-80°F)
0.6 - 0.9 Ohms	6,000 - 9,000 Ohms

TORQUE CHART

DESCRIPTION	TORQUE
Camshaft Position Sensor Bolt—4.7L V-8 Engine	12 N·m (106 in. lbs.)
Crankshaft Position Sensor—2.5L Engine	19 N·m (15 ft. lbs.)
Crankshaft Position Sensor—3.9L/5.2L/5.9L Engines	8 N·m (70 in. lbs.)
Crankshaft Position Sensor Bolt—4.7L V-8 Engine	28 N·m (21 ft. lbs.)
Distributor Hold Down Bolt	23 N·m (17 ft. lbs.)
Ignition Coil Mounting (except 4.7L) (if tapped bolts are used)	5 N·m (50 in. lbs.)
Ignition Coil Mounting (except 4.7L) (if nuts/bolts are used)	11 N·m (100 in. lbs.)
Ignition Coil Mounting Nut—4.7L V-8 Engine	8 N·m (70 in. lbs.)
Spark Plugs—Except 4.7L	35–41 N·m (26–30 ft. lbs.)
Spark Plugs—4.7L V-8 Engine	27 N·m (20 ft. lbs.)